SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

THREE / FOUR-YEAR DEGREE OF BACHELOR OF SCIENCE

Bachelor of Science

SUBJECT: MATHEMATICS

FACULTY: SCIENCE AND TECHNOLOGY

(Courses effective from Academic Year 2026-2027)
Under Uniform NEP 2020

SYLLABUS

Semester I and II
Semester III and IV
Semester V and VI

Faculty: Science and Technology

Programme: B. Sc. (Mathematics)

POs:

At the end of the programme, graduates would be able to

1. Enhance the knowledge in all basic sciences.
2. Determine, Create and Implement solutions for Computational Problems.
3. Develop scientific temper and think in a critical manner.
4. Build up progressive and successful career in academics, industry and society.
5. Develop students' abilities and aptitudes to apply the mathematical ideas.

PSOs :

Upon completion of the programme successfully, students would be able to

1. Understand major concepts in all disciplines of Mathematics.
2. Formulate and develop Mathematical arguments in a logical manner.
3. Develop knowledge and Comprehension of Advanced Mathematics.
4. Create an awareness of the impact of Mathematics on the environment, society and development outsidethe scientific community.
5. Create sensitivity towards environmental concerns and contribute in the development of nation.
6. Quantitative technique for banking examination and Industry readiness

Employability Potential of the Programme:

Career options for students pursuing a B.Sc. in Mathematics (major subject) are not limited to solving complex equations. Apart from the traditional career paths in academics and research, there are numerous opportunities available in sectors such as banking, corporate industries, accounting, finance, insurance, teaching, and information technology. Mathematics graduates can also pursue careers in fields like law, management, and healthcare-related analytics. A degree in Mathematics often provides students with an advantage in placements due to their strong analytical and problem-solving abilities compared to many other science disciplines.

After completing a B.Sc. in Mathematics, students may choose either higher studies or employment opportunities. Both options offer promising career prospects. Students can pursue higher education such as M.Sc. in Mathematics, followed by M.Phil. or Ph.D., leading to careers in research and academia as mathematicians, researchers, or assistant professors. They may also pursue a B.Ed. degree to become school teachers. In addition, Mathematics graduates are highly suited for emerging and interdisciplinary fields that require strong quantitative and analytical skills, including:

- Data Science
- Machine Learning
- Artificial Intelligence
- Actuarial Science
- Statistics and Analytics

- Financial Modeling
- Operations Research
- Computer Programming and Software Development

There are also excellent opportunities in government and private sectors. Competitive examinations such as UPSC, MPSC, SSC, Railways, Banking, and other public service commission's provide prestigious career options for Mathematics graduates.

Thus, the programme offers diverse and rewarding career opportunities across academic, industrial, technological, financial, and government as well as private sectors.

Sant Gadge Baba Amravati University, Amravati

Syllabus for B. Sc. I (Mathematics) Sem I & Sem II (NEP)

w. e. f. Academic Session 2024-25 &

Revised from Academic Session 2026-27

UG Program (NEP) Semester I

Program: B. Sc.- I (Mathematics) Semester - I

Course Code / Subject: 126200 / Mathematics

The Vertical/ Type of Course: Major/Minor: Theory -1

Course Name: Algebra and Calculus

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- Understand the concept of matrix rank and distinguish between row rank and column rank and verify their equality.
- To Understand complex numbers and their cartesian and polar form. To study trigonometric and hyperbolic function.
- To analyse concept of limit, continuity and their properties. Apply concepts of limits and continuity to mathematical, scientific, and engineering problems.

Unit	**Content**
Unit I	Rank of a Matrix: Row Rank, Column Rank, Eigen Values, Eigen Vectors and the Characteristic Equation of a Matrix, Cayley-Hamilton theorem, Inverse by Cayley-Hamilton theorem. **(08 Hrs.)**
Unit II	De Moivre's theorem: Roots of Complex Number, Circular Functions, Hyperbolic Function, Inverse Hyperbolic Function, Relation between Circular Functions and Hyperbolic Functions. **(07 Hrs.)**
Unit III	Limit of a function: ε-δ definition, basic properties of limits, some standard limits, Continuous and Discontinuous functions, Types of Discontinuity. **(08 Hrs.)**
Unit IV	Mean Value Theorems: Rolle's theorem, Lagrange's Mean Value theorem, Cauchy's Mean Value theorem, Maclaurin's and Taylor's series expansions. **(07 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** Evaluate the characteristic equation, Eigen Value and corresponding Eigen Vector of a given matrix. **CO2:** Study applications of De Moivre's theorem. **CO3:** Study of Limit and Continuity of function and its basic properties. **CO4:** Describe the applicability of mean value theorems.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

1] Elements of Algebra and Calculus: V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari, Dnyanpath Publication, Amravati, (M. S.) India, First Edition, 2024.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari: A Text book

of Algebra and Trigonometry, Dnyanpath Publication, Amravati, First Edition, 2022.
2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari: A Text book of Differential and Integral Calculus, Dnyanpath Publication, Amravati, First Edition, 2022.
3] T. M. Karade, Maya S. Bendre, V. G. Mete, V. P. Kadam, S. N. Bayaskar, P. P. Khade, Priyanka B. Gaikwad: Elements of Algebra and Calculus. Sonu-Nilu, Nagpur, 2024.
4] K. B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
5] H. S. Hall and S. R. Knight, Higher Algebra, H. M. Publications, 1994.
6] Hohn Franz E: Elementary Matrix Algebra, Amerind Publishing Co., Pvt. Ltd. 1964.
7] Ayres Jr Frank: Matrices: Schaum's outline series, McGraw Hill Book Company, Singapore, 1983.
8] Shanti Narayan: A Test Book of Matrices, S. Chand & Co. Delhi.
9] Shanti Narayan and Dr. P. K. Mittal: Differential Calculus by, S. Chand and Co. Ltd. Revised Edition 2012 (Reprint 2014).
10] Gorakh Prasad:Text book on Differential Calculus by, Pothishala Private limited Allahabad.
11] Ayres F :Calculus, Schaum's outline series, Mc Graw Hill, 1981.
12] Mac Millan: Differential calculus by Edwards, and Co. Ltd.
13] N. Bali: Golden Differential Calculus, Laxmi Publication Pvt Ltd.
14] Murray and R Spiegel :Theory and Problems on Advance Calculus by, Schaum Pub. Co. New York.
15] Edwards J : Differential Calculus for Beginners, MacMillan and Co.Ltd.,1963.
16] Greenspan D. : Introduction to Calculus, Harper and Row, 1968.
17] Gorakh Prasad: Differential Calculus, Pothishala Pvt. Ltd., Allahabad, 1963

Program: B. Sc.- I (Mathematics) Semester - I

Course Code / Subject: 126201 / Mathematics

The Vertical/ Type of Course: Major/Minor: Lab Course – I

Course Name: Practical Based on Algebra and Calculus (126200)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- Compute the rank, row rank, and column rank of a matrix using appropriate matrix operations and techniques. Also to find inverse of Matrix by using Cayley Hamilton theorem.
- Discuss the relationship between circular functions and hyperbolic functions, including their definitions, identities, and interconnections.
- Explain and apply the fundamental properties of limits of functions, including uniqueness, addition, subtraction, multiplication, and division theorems.
- Discuss and verify the applicability of Rolle's Mean Value Theorem, Lagrange's Mean value theorem & Cauchy's Mean value theorem for different classes of functions by checking the required conditions.

Course Outcomes:

After successful completion of this course students will able to:

CO1: Evaluate the Characteristic equation, Eigen Values and corresponding Eigen Vectors of a given Matrix.
CO2: Study applications of De Moivre's theorem.
CO3: Define Limit and study the basic properties.
CO4: Classify Continuity and Discontinuity of the functions.
CO5: Describe the geometrical applications of mean value theorems.

Sr. No.	List of Practical's to be covered	No. of Examples
Practical Based on Elements of Algebra and Calculus (126200)		
Practical Based on Group A		
1	To compute Rank, Row Rank and Column Rank of a Matrix.	03
2	To find Eigen values and Eigen vectors of a given matrix.	03
3	To verify Cayley- Hamilton theorem for the given matrix.	03
4	To apply De Moivre's theorem for solution of given polynomial equation.	03
5	To discuss the relation between Circular Functions and Hyperbolic Functions.	03
6	To separate real and imaginary parts of a Circular and Hyperbolic functions.	03
Practical Based on Group B		
7	To explain basic properties of limit of function (Uniqueness, Addition, subtraction, multiplication and division of two functions).	03
8	To find δ, by using ε-δ definition of limit for various functions.	03
9	To explain the types of discontinuity with various examples	03
10	To discuss applicability of Rolle's mean value theorem for various functions.	03
11	To discuss applicability of Lagrange's and Cauchy's mean value theorem for various functions.	03
12	To discuss applicability of Taylors and Maclaurin's series of expansions for various functions.	03
Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**

Practical Book:

A Practical Book Based on Algebra and Calculus: V. A. Sharma, V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari Dnyanpath Publication, Amravati (MS), India, First Edition, 2024.

Reference Books:

1] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari: Elements of Algebra and Calculus, Dnyanpath Publication, Amravati, (M. S.) India, First Edition, 2024.

2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari : A Text book of Algebra and Trigonometry, Dnyanpath Publication, Amravati, First Edition, 2022.

3] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari : A Text book of Differential and Integral Calculus: Dnyanpath Publication, Amravati, First Edition, 2022.

4] Om P. Chug, Kulbhushan Prakash, A. D. Gupta: Topics in Algebra, Anmol Publications Pvt. Ltd., New Delhi, First Edition 1997.

5] Shanti Narayan and Dr. P. K. Mittal: Differential Calculus by, S. Chand and Co. Ltd. Revised Edition 2012 (Reprint 2014).

6] Shanti Narayan : A text books of Matrices, S. Chand & Company Ltd, Ram Nagar, New Delhi.

7] K.B. Datta: Matrix & Linear Algebra, DHI Publication.

8] Shanti Narayan: Differential Calculus by, S. Chand and Co. Ltd.

9] Gorakh Prasad:Text book on Differential Calculus by, Pothishala Private limited Allahabad.

10] Ayres F :Calculus, Schaum's outline series, Mc Graw Hill, 1981.

11] Mac Millan: Differential calculus by Edwards, and Co. Ltd.

12] N. Bali: Golden Differential Calculus, Laxmi Publication Pvt Ltd.

13] Murray and R Spiegel :Theory and Problems on Advance Calculus by, Schaum Pub. Co. New York.

14] Edwards J : Differential Calculus for Beginners, MacMillan and Co.Ltd.,1963.
15] Greenspan D. : Introduction to Calculus, Harper and Row, 1968.
16] Gorakh Prasad: Differential Calculus, Pothishala Pvt. Ltd., Allahabad, 1963.

Program: B. Sc.- I (Mathematics) Semester- I

Course Code / Subject: 126202 / Mathematics

The Vertical/ Type of Course: Generic/ Open Elective / Theory 1

Course Name: Foundation of Mathematics

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- Understand the concept and classification of number systems, including natural numbers, integers, rational numbers, irrational numbers, and real numbers.
- Understand coordinate systems and locate points on a line and in a plane using appropriate coordinate representations. And apply the concepts of absolute value, distance formula, and midpoint formula to solve geometric and analytical problems.
- Describe and analyze sets and their properties, including subsets, set operations, indexed collections of sets, partitions, Cartesian products, and numerically equivalent sets.
- Explain the concept of functions and classify them as one-to-one, onto, and bijective functions.

Unit	**Content**
Unit I	Number System: Natural numbers, properties of Natural numbers, Integers, Rational and Irrational numbers, Real numbers, properties of Real numbers. **(07 Hrs.)**
Unit II	Co- ordinates Systems and Graphs of Equations: The co-ordinate of a point on a line, Absolute value, co-ordinate of a point in a plane, Distance formula, Midpoint formulas, Graphs of equation, Straight Line, Slope, Equation of a Line, Parallel Lines, Perpendicular Lines. **(08 Hrs.)**
Unit III	Sets: Describing a Set, Subsets, Set operations, indexed collections of sets, partitions of sets, Cartesian Product of sets, Numerically equivalent sets. **(07 Hrs.)**
Unit IV	Relations and Functions: Relations, properties of Relations, Equivalence Relations, properties of Equivalence Classes, definition of Function, set of all functions from A to B, one to one and onto functions, Bijective functions, Composition of functions, Inverse Functions. **(08 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** Classify Number System and discuss properties of Real numbers. **CO2:** Find slopes of line and to write the equations of line. **CO3:** Describe sets and perform the basic set operations. **CO4:** Define and identify an equivalence relation and classify the functions.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

1] A Text Book of Foundation of Mathematics: V. A. Sharma, V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari, Dnyanpath Publication, Amravati (MS), India, First Edition, 2024.

Reference Books:

1] George B. Thomas, Jr. And Ross I.: Finney Calculus and Analytical Geometry (Pearson).
2] Gary Chartrand, Albert D. Polimeni and Ping Zhang: Mathematical Proof A Transition to Advanced Mathematics, 3rd Edition, Pearson.

3] Ian Stewart and Daavid Tall: The Foundations of Mathematics, 2nd Edition, Oxford.

Program: B. Sc.- I (Mathematics) Semester- I

Course Code / Subject: 126203 / Mathematics

The Vertical/ Type of Course: Generic/ Open Elective / Theory - 2

Course Name: Financial Mathematics-I

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- Understand and perform operations on fractions, including simplification, comparison, addition, subtraction, multiplication, and division and solve mathematical problems.
- Understand and apply the concepts of profit and loss to solve commercial and business-related mathematical problems.
- Apply the concepts of ratio and proportion to solve quantitative and real-life mathematical problems.
- To interpret and analyze the data presented in tables, charts, graphs, and other forms of data representation.

Unit	**Content**
Unit I	Fractions, Decimal Numbers, Algebra of Numbers. **(07 Hrs.)**
Unit II	Profit and Loss, Percentages, Averages. **(07 Hrs.)**
Unit III	Ratio and Proportion, Simple and Compound Interest. **(08 Hrs.)**
Unit IV	Data Interpretation, Linear Programming Problem. **(08 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO1: Solve the problems using the concepts of fractions, decimal numbers and algebra of numbers.

CO2: Analyse the financial problems using the concepts of profit, loss, percentages and averages.

CO3: Evaluate the financial condition based on one's income or expenditure using the concepts of ratio, proportion and interest etc.

CO4: Apply the techniques of LPP to solve real world problems.

Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

1] A Text Book of Financial Mathematics-I: V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, S. R. Kumbhare, Dnyanpath Publication, Amravati (MS), India, First Edition, 2024.

Reference Books:

1] K. Selva Kumar: Financial Mathematics and its Applications, Notion Press Chennai.

2] A. Lenim Jothi: Financial Mathematics, Himalaya Publication, Mumbai, No. 1, 2009.

3] A. P. Verma: Business Mathematics, Asian Books Private Limited, New Delhi, No. 3 January 2007.

Program: B. Sc.- I (Mathematics) Semester- I

Course Code / Subject: 126204 / Mathematics

The Vertical/ Type of Course: SEC (Skill Enhancement Course) / Lab Course 2

Course Name: Applied Mathematics

Total Number of Hours/ Week: 4 Hrs.

Course Objectives:

- Understand the fundamental concepts of mensuration and their applications in solving geometric problems.
- Understand the concepts of time, work, and wages and apply them to solve problems involving individual and combined work efficiency. Also to analyze and solve problems involving boats and streams.
- Understand and apply the concepts of degree and radian measures and convert angles between these two systems.
- Use graphical and chart-based representations of data to analyze trends, patterns, relationships, and make informed decisions.

Unit	**Content**
Unit I	Mensuration: Perimeter of Circle, Square and Rectangle, Area of Circle, Square, Rectangles and Triangles, Surface Area of Cylinder, Sphere, Cone. **(07 Hrs.)**
Unit II	Time, Work, Wages: Introduction, Finding Time and Amount of Work, Finding Speed, Distance and Time, Finding Speed of Boats and Stream. **(08 Hrs.)**
Unit III	Trigonometry: Degree and Radian, Trigonometric Ratio and Identities, Angle of Elevation and Depression, Height and Distance Problem. **(08 Hrs.)**
Unit IV	Data Interpretation: Tabulation, Missing Data Problem. Graph and Charts- Table, Line, Bar, Pie. **(07 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** Acquire the knowledge of geometrical shapes and their equations. **CO2:** Evaluate the problems on Time, Work and Wages. **CO3:** Apply the various trigonometric concepts in real life situations. **CO4:** Achieve skills of comparison through graphs and charts.	

Practical Book:

A Practical Book on Applied Mathematics: V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari, P. B. Gaikwad, S. L. Munde, P. R. Patil, M. S. Palaspagar, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] R. S. Agrawal**:** Objective Arithmetic, S. Chand & Company Ltd.

2] S. K. Sharma and G. Kaur**:** Business Mathematics, Sultan Chand & Sons.

Sr. No.	**List of Practical's to be covered**
	Practical Based on Group A
1	To find Perimeter of Circle, Rectangle and Square.
2	To find the Area of Circle with different radius.
3	To find Surface Area of Cylinder, Cone and Sphere.
4	To evaluate the problems of Work, Time, Distance and Wages.
5	To evaluate the problems of Displacement, Velocity and Acceleration.
6	To find the Speed of Boat and Stream.
	Practical Based on Group B
1	To evaluate the problems on Trigonometric Ratio and Identities.
2	To solve the problems Angle of Elevation and Angle of Depression.
3	To evaluate problems on height and distances.
4	To perform graphical representation of data.

5	To plot the Line and Bar graphs of various data.
6	To plot Pie charts for different data.
Internal Practical Assessment **(50 Marks)**	**1.** Practical Perform – **30 Marks** (Perform any one from group A and B, each carry **15 marks**) **2.** Practical Record- **10 Marks** **3.** Viva voce – **10 Marks**

UG Program (NEP) Semester II

Program: B. Sc.- I (Mathematics) Semester - II

Course Code / Subject: 126205 / Mathematics

The Vertical/ Type of Course: Major/Minor: Theory - 2

Course Name: Vector Analysis and Geometry

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To Understand and apply scalar and vector products of three & four vectors in solving geometrical and physical problems. Also to perform vector differentiation and integration to analyze vector-valued functions.
- To analyze space curves and determine the tangent, normal, and binormal (T–N–B) vectors, along with the associated fundamental planes.
- Understand and evaluate vector differential operators, including gradient, divergence, and curl, and interpret their physical and geometrical significance.
- Understand and represent spheres in different forms and derive their standard equations in three-dimensional geometry.

Unit	**Content**
Unit I	Scalar and Vector product of three vectors, Product of four vectors, Vector Differentiation and Vector Integration. **(08 Hrs.)**
Unit II	Space Curve, t, n, b Vectors, Fundamental Planes, Curvature, Torsion, Frenet-Serret Formula. **(07 Hrs.)**
Unit III	Gradient, Divergence and Curl, Directional Derivative. **(08 Hrs.)**
Unit IV	Sphere: Different forms of Sphere, Section of a Sphere by a Plane, Sphere through a given Circle, Orthogonal Sphere and Condition of Orthogonality. **(07 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** Interpret the vectors, their products, differentiation and integration. **CO2:** Define and determine the curvature and torsion of a curve. **CO3:** Apply the concepts of divergence, curl which are useful in Physics. **CO4:** Study different forms of sphere.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

1] A Textbook of Vector Analysis and Geometry: V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, Dnyanpath Publication, Amravati (M.S.), India, First Edition, 2025.

Reference Books:

1] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari : A Text book of Vector Analysis and Geometry, Dnyanpath Publication, Amravati, First Edition, 2022.
2] Murray R. Spiegel, Vector Analysis, Schaum Publishing Company, New York,1981.
3] N. Saran and S. N. Nigam, Introduction to vector Analysis Pothishala Pvt. Ltd. Allahabad.
4] Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Co. New Delhi.
5] R. J. T. Bell, Elementary Treatise on Co-ordinate Geometry of Three Dimensions, Macmillan India Ltd., 1994.
6] P. K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd., 1999.
7] N. Saran and R. S. Gupta, Analytical Geometry of three dimensions, Pothishala Pvt. Ltd. Allahabad, 2000.

Program: B. Sc.- I (Mathematics) Semester - II

Course Code / Subject: 126206 / Mathematics

The Vertical/ Type of Course: Major/Minor: Lab Course - 3

Course Name: Practical Based on Vector Analysis and Geometry (126205)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- Perform vector differentiation and integration to solve problems involving vector-valued functions using appropriate differentiation techniques.
- To determine the equations of the fundamental planes (tangent, normal, and osculating planes) of a space curve.
- Demonstrate and apply the concepts of gradient, divergence, and curl for scalar and vector functions, and interpret their geometric and physical significance.
- Apply the concept of orthogonality of spheres and solve problems using the condition of orthogonality.

Course Outcomes:

After successful completion of this course students will able to:
CO1: Interpret the vectors, their products, differentiation and integration.
CO2: Studies space curves and fundamental planes.
CO3: Apply the concepts of divergence, curls which are useful in Physics.
CO4: Study of sphere and its orthogonality.

Sr. No.	List of Practical's to be covered	No. of Examples
Practical Based on Vector Analysis and Geometry (126205)		
Practical Based on Group A		
1	To solve the examples on Scalar and Vector triple product of three vectors.	03
2	To calculate product of four vectors.	03
3	To solve the problems on Vector Differentiation.	03
4	To solve the problems on Vector Integration.	03
5	To obtain the expression for t, n, b vectors.	03
6	To determine the equations of Fundamental Planes.	03
Practical Based on Group B		
7	To obtain the formulae for Curvature and Torsion of curve.	03
8	To prove Frenet-Serret formulae.	03
9	To demonstrate the concept of Gradient, Divergence and Curl of a vector function.	03
10	To solve the problems on Directional Derivative.	03
11	To obtain different forms of Sphere.	03
12	To solve examples on Orthogonality of Sphere.	03

Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce– **10 Marks**
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**

Practical Book:

Practical book based on Vector Analysis and Geometry: V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, Dnyanpath Publication, Amravati (MS), India, First Edition, 2025.

Reference Books:

1] V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari : A Textbook of Vector Analysis and Geometry, Dnyanpath Publication, Amravati (M.S.), India, First Edition, 2025.

2] V. A. Sharma**,** S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari : A Text book of Vector Analysis and Geometry, Dnyanpath Publication, Amravati, First Edition, 2022.

3] Murray R. Spiegel, Vector Analysis, Schaum Publishing Company, New York,1981.

4] N. Saran and S. N. Nigam, Introduction to vector Analysis Pothishala Pvt. Ltd. Allahabad.

5] Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Co. New Delhi.

6] R. J. T. Bell, Elementary Treatise on Co-ordinate Geometry of Three Dimensions, Macmillan India Ltd., 1994.

7] P. K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd., 1999.

8] N. Saran and R. S. Gupta, Analytical Geometry of three dimensions, Pothishala Pvt. Ltd. Allahabad, 2000.

Program: B. Sc.- I (Mathematics) Semester- II

Course Code / Subject: 126207 / Mathematics

The Vertical/ Type of Course: Generic/ Open Elective / Theory-3

Course Name: Numerical Ability- I

Total Number of Hours/week: 2 Hrs.

Course Objectives:

- Understand the structure and properties of number systems and apply them in mathematical computations.
- Apply the laws of surds and indices to simplify expressions and solve mathematical problems efficiently.
- Apply the principles of permutations and combinations to count and analyze possible arrangements and selections in various situations.
- Solve quantitative aptitude problems involving boats and streams and train-related motion, using concepts of relative speed, distance, and time.

Unit	**Content**
Unit I	Number System, H.C.F and L.C.M of Numbers. **(07 Hrs.)**
Unit II	Square Roots and Cube Roots, Surds and Indices. **(08 Hrs.)**
Unit III	Permutations and Combinations, Probability. **(07 Hrs.)**
Unit IV	Boats and Stream, Problems on Train, Allegation or Mixture. **(08 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO1: Restate the ideas and concepts of L.C.M and H.C.F of a numbers.
CO2: Restate the ideas and concept of Surds and Indices and also find Square and Cube Roots.
CO3: Understand the concept of Permutations and Combinations as well as Probability.
CO4: Restate the ideas and concepts of Boats and Stream.

Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

1] A Text Book of Numerical Ability-I: V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. P. Wasnik, Dnyanpath Publication, Amravati (MS), India, First Edition, 2025.

Reference Books:

1] R. S. Agrawal: Quantitative aptitude for Competitive examination, S. Chand Publication.
2] Arun Sharma: How to Prepare for quantitative Aptitude for CAT, Mac Grow Hill Publication.
3] Abhijit Guha: Quantitative Aptitude for competitive examinations, Tata McGraw Hill Education Private Ltd. (Fourth Edition).

Program: B. Sc.- I (Mathematics) Semester - II

Course Code / Subject: 126208 / Mathematics

The Vertical/ Type of Course: Generic/ Open Elective / Theory-4

Course Name: Mathematics for Social Sciences

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- Apply the concepts of algebra and inequalities to solve mathematical and quantitative problems.
- Solve simultaneous linear equations using graphical and algebraic methods
- Analyze and solve non-linear equations, including quadratic functions, and apply them to problems involving revenue, cost, and profit.
- Understand the fundamentals of mathematical logic, including statements, symbolic notation, and propositional connectives.

Unit	**Content**
Unit I	**Algebra:** Inequalities, Algebra of Numbers, Transposition of formulae, National Income Determination. **(07 Hrs.)**
Unit II	**Linear Equations:** Graphs, Solution of Simultaneous Equations, Supply and Demand Analysis. **(08 Hrs.)**
Unit III	**Non-linear Equations:** Quadratic Functions, Revenue, Cost and Profit, Indices and Logarithms, Exponents and Natural Logarithmic Functions. **(07 Hrs.)**
Unit IV	**Mathematical Logic:** Statements and Notation, propositional connectives, Normal Forms, truth tables. **(08 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** Solve application problems on Interest with emphasis on Business and Social Sciences. **CO2:** Understand the concept of Interest and its computations. **CO3:** Perform the calculations using Logarithms. **CO4:** Apply Mathematical Logic to solve problems.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

1] A Text Book of Mathematics for Social Sciences: V. A. Sharma, S.R. Bhoyar, G. U. Khapekar, V. R. Patil, T. D. Nakade, Dnyanpath Publication, Amravati (MS), India, First Edition, 2025.

Reference Books:

1] Ian Jacques: Mathematics for Economics and Business, 5th Edition, Pearson Education Limited.
2] Steven T. Karris: Mathematics for Business, Science and Technology, Third Edition, Orchard Publication.
3] Luis Moises Pena-Levano: Calculus for Business, Economics and Finance (Schaum's Outline), Fourth Edition, McGraw Hill.
4] J. P. Tremblay, R. Manohar: Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill Edition.

Program: B. Sc.- I (Mathematics) Semester-II

Course Code / Subject: 126209 / Mathematics

The Vertical/ Type of Course: VSC (Vocational Skill Course) / Lab Course-4

Course Name: Mathematics in MS-Office

Total Number of Hours/Week: 4 Hrs.

Course Objectives:

- Understand the basic features and interface of MS Word, including its workspace, menus, toolbars, and document management options.
- Apply basic text formatting techniques in MS Word, including changing font styles, font sizes, and using bold, italic, and underline effects etc.
- Type and format mathematical symbols, equations, and formulas accurately using the built-in tools of MS Word.
- Design and develop mathematical presentations by adding, editing, and formatting text, equations, and other content effectively.

Unit	Content
Unit I	Basics of MS-Office Word: Overview of MS Word, Options for viewing a document in Word, writing right away– some important buttons and guidelines, Saving documents using files and folders, Save and Save As, Closing a document. **(07 Hrs.)**
Unit II	Setting in MS-Office: Changing the Font and Font Size, Bold, italic, and Underline, Paragraph Formatting, Borders and Shading, Working with Indents, working with Line Spacing, Using Tabs. **(07 Hrs.)**
Unit III	Mathematical Type Setting in MS-Office Word: Introduction to Equation Editor, How to type mathematical symbol and equations, Adding page numbers, Header and Footer to documents. **(08 Hrs.)**
Unit IV	Power Point Presentation for Mathematics: Introduction to Presentation – Opening New Presentation, Different Presentation Templates, Setting Backgrounds, Selecting Presentation Layouts, Creating a presentation-Setting, Presentation Style, Adding Text to the Presentation, Formatting a Presentation-Adding style, Colour, Arranging Objects, Adding Header & Footer, Slide Background, Slide Layout. **(08 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO1: Perform various features of MS Word as like Viewing, Writing, Saving and Closing a word document.
CO2: Apply various settings in MS-Word file.
CO3: Learn to type of different mathematical equations/expressions using Equation Editor.
CO4: Prepare presentation using Power Point.

Practical Book:

Practical Book on Mathematics in MS Office: V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, P. B. Gaikwad, Y. U. Naner, A. M. Bagade, R. A.Wasnik, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] K. Selva Kumar: Financial Mathematics and its Applications, Notion Press Chennai.
2] A. Lenim Jothi: Financial Mathematics, Himalaya Publication, Mumbai, No. 1, 2009.
3] A. P. Verma: Business Mathematics, Asian Books Private Limited, New Delhi, No. 3 January 2007.

Sr. No.	List of Practical's to be covered
Practical Based on Group A	
1	To create a document and apply different formatting options.
2	To design a Greeting Card using Word Art for different festivals.
3	To create your biodata and use page borders and shading.
4	To create a document and insert header and footer, page title etc.
5	To create a document, set the margins, orientation, size column, water mark, page colour and page border.
Practical Based on Group B	
1	To insert a table into the document.
2	To prepare a marksheet of your class subjects.
3	To type various mathematical equations using Equations Editor.
4	To create power point presentation, insert tables, images and shapes.
5	To make power point slide by adding transitions and animations.
Internal Practical Assessment (50 Marks)	**1.** Practical Perform – **30 Marks** (Perform any one from group A and B, each carry **15 marks**) **2.** Practical Record- **10 Marks** **3.** Viva voce– **10 Marks**

Program: B. Sc.- I (Mathematics) Semester - II

Course Code / Subject: 126210 / Mathematics

The Vertical/ Type of Course: SEC (Skill Enhancement Course) / Lab Course - 5

Course Name: Transportation and Game Theory

Total Number of Hours/ Week: 4 Hrs.

Course Objectives:

- Understand the concept of the Transportation Problem and its significance in operations research and optimization
- Understand the concept of the Assignment Problem and its applications in optimal resource allocation and decision-making.
- Understand the fundamental concepts of Game Theory and their applications in decision-making and competitive situations.
- Understand and apply graphical methods to solve optimization and game theory problems involving two variables.

Unit	Content
Unit I	Transportation Problem: Transportation Problem and its mathematical formulation, North-West Corner Method, Least Cost Method. **(08 Hrs.)**
Unit II	Assignment problem: Assignment problem and its mathematical formulation, Unbalanced Assignment Problems. **(07 Hrs.)**
Unit III	Game Theory: Formulation of Two-person Zero-sum Game, solving two-person zero-sum game in terms of mixed strategies. **(07 Hrs.)**
Unit IV	Graphical Solution: Graphical solution problem, concept of Dominance. **(08 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** Interpret the transportation models' solutions and infer solutions to the real-world	

problems.
CO2: Finding initial basic feasible and optimal solution of the Transportation problems.
CO3: Compute Game Theory Problems.
CO4: Recognize and solve game theory and Assignment problems.
CO5: Analyse pure and mixed strategy games.
CO6: Determine the best strategy and value of the given game model.

Practical Book:
Practical Book on Transportation and Game Theory: V. A. Sharma, V. R. Patil, S. R. Bhoyar, A. N. Rangari, G. U. Khapekar, R. R. Atram, S. C. Darunde, G. D. Kanade, A. F. Gotarkar, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:
1] H. A. Taha, Operation Research-an Introduction, Macmillan Publishing Company, Inc, New York.
2] Operations Research - H. A. Taha, Pearson, 7th Edition, June 2002.
3] Introduction to Operations Research - Hiller and Liberman, MGH, 7th Edition, 2002.
4] Prem Kumar Gupta and D.S. Hira, Operation Research-an Introduction, Chand & Company Ltd., New Delhi.
5] F.S. Hillier and G.J. Lieberman, Introduction to Operations Research (6thEd.) McGraw Hill International Edition, Industrial Engineering Series,l995.
6] Wagner H. M., "Principles of Operations Research", Prentice Hall India.
7] Kanti Swaroop, P. K. Gupta and Manmohan, Operations Research, Sultan Chand &Sons, New Delhi 2007.
8] Operations Research - S.D. Sharma, Kedarnath Ramnath & Co, 2008.
9] Operations Research - Theory and Applications, J.K Sharma, Macmillan Publications India Ltd, 2013.

Sr. No.	List of Practical's to be covered
Practical Based on Group A	
1	To solve the transportation problems by North West Corner Rule for IBFS.
2	To solve the transportation problems by Least Cost method for IBFS.
3	To solve the balanced assignment problems.
4	To solve the unbalanced assignment problems.
5	To solve the travelling salesman problems.
6	To solve the algorithm for North West Corner method.
Practical Based on Group B	
1	To solve the Maxmin and Minmax Principle.
2	To solve the game problems with saddle point.
3	To solve the 2 x 2 game without saddle point.
4	To obtain the graphical solution of 2 x n game.
5	To obtain the graphical solution of m x 2 game.
6	To find the solution of game by using dominance property.
Internal Practical Assessment (50 Marks)	**1.** Practical Perform – **30 Marks** (Perform Any one from group A and B, each carry **15 marks**) **2**. Practical Record- **10 Marks** **3.** Viva voce – **10 Marks**

Examination, Evaluation and Assessment Scheme

Vertical No.	The Vertical	Mode of Examination, Evaluation & Assessment	Theory				Theory (Total)		Practical				Practical (Total)	
			External		Internal				External		Internal			
			Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
a	Major	External &	**30**	**9**	**20**	**6**	**50**	**20**	**25**	**10**	**25**	**10**	**50**	**20**
b	Minor	Internal	**30**	**9**	**20**	**6**	**50**	**20**	**25**	**10**	**25**	**10**	**50**	**20**
c	Generic/ Open Elective	Internal	--	--	**50**	**20**	**50**	**20**	--	--	--	--	--	--
d	VSC	Internal	--	--	--	--	--	--	--	--	**50**	**20**	**50**	**20**
	SEC	Internal	--	--	--	--	--	--	--	--	**50**	**20**	**50**	**20**
e	AEC (Eng. & One MIL Composite)	Internal	--	--	**50**	**20**	**50**	**20**	--	--	--	--	--	--
	IKS (Generic)	Internal	--	--	**50**	**20**	**50**	**20**	--	--	--	--	--	--
	VEC	Internal	--	--	--	--	--	--	--	--	--	--	--	--
f	Internship/ Apprenticeship FP/CEP CC	Internal	Assessment of these verticals shall be based on various activities/practices. The evaluation/assessment shall be done by appointing external examiner by principal from Industry/Organization/Academia. The mentor faculty shall be the internal examiner. It shall be evaluated by giving maximum 50 marks per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately.											

Appendix-A
INSTRUCTIONS FOR THE PAPER SETTERS
w.e.f. 2024-25
Subject: Mathematics

External University Examination

Sr. No	Program	Marks of theory paper	Internal Marks	Total	Instructions
1	UG – NEP (Mathematics) Major/Minor/Generic/ Open Elective	30	20	50	Total Units: 04 **(Two units for 08 Marks and Two units for 07 Marks)**
	SEM I AND SEM II				**Paper setting for 08 Marks:** Question 1. a) 04 Marks OR b) 04 Marks Question 1. c) 04 Marks OR d) 04 Marks **Paper setting for 07 Marks:** Question 2. a) 04 Marks OR b) 04 Marks Question 2. c) 03 Marks OR d) 03Marks

Note: The strength of the batch of the practical for UG classes shall be of 16 students with an addition of 10% with the permission of Honourable Vice Chancellor. (As per NEP-2020 Scheme of SGBAU, Amravati, A-1686).

Model Question Paper

Major/Minor

B.Sc. (Part I) Semester I (NEP) Examination

Course Code: 126200

Algebra and Calculus

Time: 2 Hours **Maximum Marks: 30**

Note: 1. In each unit solve (a) or (b) and (c) or (d).

UNIT I

Que:- 1 (a) Verify Cayley-Hamilton's theorem for the matrix $A=\begin{bmatrix} 0 & 0 & 1 \\ 3 & 1 & 0 \\ -2 & 1 & 4 \end{bmatrix}$ **4**

OR

(b) Verify Cayley-Hamilton theorem for matrix A and hence find A^{-1} if

$$A=\begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$$ **4**

(c) Show that the eigenvalues of a Hermitian matrix are all real. **4**

OR

(d) Verify Cayley-Hamilton's theorem for the matrix $M=\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$. **4**

Hence find M^4.

UNIT-II

Que:- 2 (a) If n is positive integer, then prove that $(\cos\theta+i\sin\theta)^n=\cos n\theta+i\sin n\theta$ **4**

OR

(b) If $\sin(A+iB)=x+iy$ then show that

i) $\frac{x^2}{\cos h^2 B}+\frac{y^2}{\sin h^2 B}=1$ ii) $\frac{x^2}{\sin^2 A}-\frac{y^2}{\cos^2 A}=1$ **4**

(c) Prove that, $\sec h^2 x+\tan h^2 x=1$ **3**

OR

(d) Prove that, $\cos h^2 x-\sin h^2 x=1$ **3**

UNIT III

Que:- 3 (a) Prove that limit of a function, if it exists is unique. **4**

OR

(b) Prove that $\lim_{x\to 3}\frac{x^3-2x^2-x-6}{x-3}=14$ **4**

(c) Prove that the function $f(x)=\sin x$ is continuous for all real values of x. **4**

OR

(d) Show that $\lim_{x\to 3}x^2=9$ by using $\varepsilon-\delta$ definition of limit of a function. **4**

UNIT-IV

Que:- 4 (a) State and prove Rolle's theorem. **4**

OR

(b) State and prove Lagrange's Mean value theorem. **4**

(c) Obtain Maclaurin's series for the function $f(x)=\log(1+x)$. **3**

OR

(d) Prove that $\cos x=1-\frac{x^2}{2!}+\frac{x^4}{4!}-\ldots\ldots\ldots\ldots$ **3**

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Sant Gadge Baba Amravati University, Amravati

Syllabus for B. Sc. II (Mathematics) Sem III & Sem IV (NEP)

w. e. f. Academic Session 2025-26 &

Revised from Academic Session 2026-27

UG Program (NEP) Semester III

Program: B. Sc.- II (Mathematics) Semester - III

Course Code / Subject: **126211** / Mathematics

The Vertical/ Type of Course: Major / Theory -3

Course Name: Trigonometric Series and Calculus

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To equip students with the knowledge and skills to understand and apply the trigonometric series
- To realize the advanced concepts of calculus and solve the problems in mathematics, physics as well as engineering.

Unit	**Content**
Unit I	Trigonometric Series: Gregory series, Euler's series, Machin's series and Rutherford series. **(08 Hrs.)**
Unit II	Differentiability: Successive differentiation, Leibnitz theorem, L' Hospital Rule **(08 Hrs.)**
Unit III	Partial Differentiation: Partial derivatives and differentiation of real valued function of two variables, Homogeneous functions, Euler's theorem on homogeneous functions. **(07 Hrs.)**
Unit IV	Integration: Evaluation of Double and Triple integral, Improper Integral (Definition only), Beta and Gamma functions, Properties of Beta and Gamma functions, Relation between Beta and Gamma functions. **(07 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** Compute summation of trigonometric series. **CO2:** Evaluate n^{th} order differentiation of function. **CO3:** Describe the applicability of Euler's theorem. **CO4:** Understand the concept of improper integral and Beta-Gamma function.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Text Book of Trigonometric Series and Calculus: V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari V. P. Kadam, K. S. Wankhade, Dnyanpath Publication, Amravati, First edition 2025.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari: A Text book of Algebra and Trigonometry, Dnyanpath Publication, Amravati, First Edition, 2022.

2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari: A Text book of Differential and Integral Calculus, Dnyanpath Publication, Amravati, First Edition, 2022.

3] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, Y. S. Solanke: A Text Book of Advanced Calculus, Dnyanpath publication, Amravati, First edition 2023.
4] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, S. R. Kumbhare, T. D. Nakade, S. H. Shaikh: A Text book of Partial Differential Equations, Dnyanpath Publication, Amravati, First Edition, 2023.
5] T. M. Karade, Maya S. Bendre, V. G. Mete, V. P. Kadam, S. N. Bayaskar, P. P. Khade, Priyanka B. Gaikwad: Elements of Algebra and Calculus. Sonu-Nilu, Nagpur, 2024.
6] T. M. Karade, J. N. Salunke, M. S. Bendre: Graduate Level Calculus, Sonu-Nilu, Publication, Nagpur.
7] Chandrika Prasad: Text Book on Algebra and Theory of equations, Pothishala Private Ltd., Allahabad.
8] H. S. Hall and S. R. Knight: Higher Algebra, H. M. Publications, 1994.
9] S. L. Loney: Plane Trigonometry Part – II, MacMillan & Co., London.
10] R. S. Verma & K. S. Shukla: Text Book on Trigonometry, Pothishala Private Ltd., Allahabad.
11] Shanti Narayan and Dr. P. K. Mittal: Differential Calculus by, S. Chand and Co. Ltd. Revised Edition 2012 (Reprint 2014).
12] Mangal Giri: Algebra and Trigonometry, Krishna's Publication, Nagpur.
13] Prasad:Text book on Differential Calculus by, Pothishala Private limited Allahabad.
14] Ayres F : Calculus, Schaum's outline series, Mc Graw Hill, 1981.
15] Mac Millan: Differential calculus by Edwards, and Co. Ltd.
16] Edwards J : Differential Calculus for Beginners, MacMillan and Co.Ltd.,1963.
17] Greenspan D. : Introduction to Calculus, Harper and Row, 1968.

Program: B. Sc.- II (Mathematics) Semester - III

Course Code / Subject: **126212** / Mathematics

The Vertical/ Type of Course: Major / Theory - 4

Course Name: Advanced Calculus

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To provide students with a rigorous understanding of advanced mathematical concepts, such as differential equations, vector calculus, and complex analysis, to solve problems in mathematics, physics, and engineering.
- To develop critical thinking, analytical skills, and problem-solving abilities among the students.

Unit	**Content**
Unit I	Limit and Continuity of functions of two variables, Algebra of limit and continuity, Taylor's theorem for function of two variables. **(08 Hrs.)**
Unit II	Maxima and Minima of two variables, Lagrange's multipliers method, Jacobian **(07 Hrs.)**
Unit III	Definition of sequence, Uniqueness of limit of sequence, Algebra of limit of a sequence, Monotonic and Bounded sequence (Definition only), Cauchy sequence. **(08 Hrs.)**
Unit IV	Series of non-negative terms, convergence of geometric series, P-series, Comparison test, Cauchy's integral test, Ratio test, Root test (Only theorem). **(07 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1**: Get knowledge of basic principles of limit and continuity, Taylor's theorem. **CO2:** Understand Lagrange's multipliers method and Jacobian. **CO3:** Learn the definition of sequence, bounded sequence and Cauchy sequence. **CO4:** Apply various tests for convergence and divergence of series.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based

	(Consider best of one for Internal Assessment) **2.** Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:
A Text Book of Advanced Calculus: V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari, Dnyanpath Publication, Amravati, First edition 2025.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, Y. S. Solanke: A Text Book of Advanced Calculus, Dnyanpath publication, Amravati, First edition 2023.
2] T. M. Karade, J. N. Salunke, A. G. Deshmukh, M.S. Bendre : Lectures on Advanced Calculus, Sonu-Nilu Publication, Nagpur.
3] Gorakh Prasad: Differential Calculus, Pothishala Pvt. Ltd., Allahabad.
4] Gorakh Prasad: Integral Calculus, Pothishala Pvt. Ltd., Allahabad.
5] Murray R. Spiegel: Theory and Problems of Advanced Calculus, Schaum Outline Series.
6] S. C. Malik and Arora: Mathematical Analysis, Wiley Estern Ltd., New Delhi.
7] O. E. Stanaitis: An Introduction to Sequences, Series and improper Integrals, Holden-Dey , Inc. San Francisco, California.
8] Earl D. Rainville : Infinite series, The Macmillan Co., New York.
9] N. Piskunov : Differential and Integral Calculus, Peace publishers, Noscow.
10] Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.
11] D. Somasundaram and B. Choudhary: A First course in Mathematical Analysis, Narosa Publ. House.

Program: B. Sc.- II (Mathematics) Semester - III

Course Code / Subject: 126213 / Mathematics

The Vertical/ Type of Course: Major / Lab Course – 6

Course Name: Practical Based on Trigonometric Series and Calculus (126211) & Advanced Calculus (126212)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- To provide hands-on experience in applying mathematical concepts, such as Fourier series and vector calculus, to solve real-world problems using computational tools and software.
- To grownup problem-solving skills, analytical thinking, and increase the computational proficiency in students.

Course Outcomes:

After successful completion of this course students will able to:
CO1: Evaluate the sum of trigonometric series.
CO2: Study applications of Leibnitz's theorem and Euler's theorem.
CO3: Find Maximum and minimum value of function by Lagrange's multiplier's method.
CO4: Learn the definition of sequence, bounded sequence and Cauchy sequence.
CO5: Apply various tests for convergence and divergence of series.

Sr. No.	List of Practical's to be covered	No. of Examples
Practical Based on Trigonometric Series and Calculus (126211) & Advanced Calculus (126212)		
Practical Based on Group A		
1	To find the trigonometric series.	03
2	To find n^{th} derivative by using Leibnitz's rule.	03
3	To find the value of limit by using L' Hospital Rule	03
4	To find the partial derivatives of some functions.	03
5	To find the degree of homogeneous function.	03
6	To verify Euler's theorem on homogeneous functions.	03
7	To Evaluate the integral by using Beta and Gamma function.	03
8	To solve the examples on relation between Beta and Gamma function.	03

	Practical Based on Group B		
9	To expand the function by using Taylor's series of function of two variables.		03
10	To find absolute maximum and minimum value of the function of two variables.		03
11	To find the maximum and minimum value of the function by using Lagrange's multiplier's method.		03
12	To find Jacobian of function		03
13	To solve the examples on monotonic and bounded sequence.		03
14	To verify the convergence and divergence of series by geometric and p-series tests.		03
15	To verify the convergence and divergence of series by comparison test, Cauchy's integral test and root test.		03
Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**	
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**	

Practical Book:

A Practical Book based on Trigonometric Series, Calculus and Advanced Calculus: V. A. Sharma, V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari, A. Y. Shaikh, K. R. Mule, K. M. Kale, S. M. Pawar, P. B. Deshmukh, Dnyanpath Publication, Amravati, First edition 2025.

Reference Books:

1] V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari V. P. Kadam, K. S. Wankhade: A Text Book of Trigonometric Series and Calculus, Dnyanpath Publication, Amravati, First edition 2025.

2] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari: A Text Book of Advanced Calculus, Dnyanpath Publication, Amravati, First edition 2025.

3] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, S. R. Kumbhare, T. D. Nakade, S. H. Shaikh: A Text book of Partial Differential Equations, Dnyanpath Publication, Amravati, First Edition, 2023.

4] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, Y. S. Solanke: A Text Book of Advanced Calculus, Dnyanpath publication, Amravati, First edition 2023.

5] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari : A Text book of Algebra and Trigonometry, Dnyanpath Publication, Amravati, First Edition, 2022.

6] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari : A Text book of Differential and Integral Calculus: Dnyanpath Publication, Amravati, First Edition, 2022.

7] T. M. Karade, J. N. Salunke, A. G. Deshmukh, M.S. Bendre: Lectures on Advanced Calculus, Sonu- Nilu Publication, Nagpur.

8] Leonord Eugene Dickson: Introduction to the theory of Algebraic equations, Maxwell Press.

9] Shanti Narayan and Dr. P. K. Mittal: Differential Calculus by, S. Chand and Co. Ltd. Revised Edition, 2012 (Reprint 2014).

10] Mangal Giri: Algebra and Trigonometry, Krishna's Publication, Nagpur.

11] Gorakh Prasad: Text book on Differential Calculus by, Pothishala Private limited Allahabad.

12] Ayres F: Calculus, Schaum's outline series, Mc Graw Hill, 1981.

13] Mac Millan: Differential calculus by Edwards, and Co. Ltd.

14] Murray and R Spiegel: Theory and Problems on Advance Calculus by, Schaum Pub. Co. New York.

15] Edwards J: Differential Calculus for Beginners, MacMillan and Co.Ltd.,1963.

16] Forsynth A. R: A Treatise on Differential Equations, (Sixth Edition), Mac Millan and Co. 1956.

17] Murray R. Spiegel, Theory and Problems of Advanced Calculus, Schaum Outline Series.

Program: B. Sc.- II (Mathematics) Semester - III

Course Code / Subject: 126214 / Mathematics

The Vertical/ Type of Course: IKS (Indian Knowledge System) - Major Specific /Theory

Course Name: Indian Knowledge System in Mathematics

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To introduces students to lives significant mathematical and astronomical contributions and lasting legacies of Indian mathematicians and astronomers Aryabhata, Srinivasa Ramanujan, Bhaskaracharya and Brahmagupta.
- To Analyze the lasting impact and influence of their discoveries on the development of mathematics and astronomy both in India and globally, tracing how their work shaped subsequent scientific thought.

Unit	**Content**
Unit I	Aryabhata: Introduction to Aryabhata and his context, Mathematical Contribution, Astronomical Contribution, Legacy and Influence. **(08 Hrs.)**
Unit II	Srinivasa Ramanujan: Early life and Education, Mathematical Contribution, Collaboration with Professor G. H. Hardy, Legacy and Influence. **(07 Hrs.)**
Unit III	Bhaskaracharya: Introduction to Bhaskaracharya and his context, Mathematical Contribution, Astronomical Contribution, Legacy and Influence. **(08 Hrs.)**
Unit IV	Brahmagupta: Introduction to Brahmagupta and his context, Mathematical Contribution, Astronomical Contribution, Legacy and Influence. **(07 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1**: Understanding contributions of Aryabhatta and their relevance today. **CO2:** Familiarity with Srinivasa Ramanujan and his context. **CO3:** Understand the Bhaskaracharya's contribution in Mathematics. **CO4:** Understanding of Brahmagupta's multifaceted contributions and their profound impact on the development of mathematics and astronomy.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Text Book of Indian Knowledge System in Mathematics: V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari, S. R. Kumbhare, Dnyanpath Publication, Amravati, First edition 2025.

Reference Books:

1] D. S. Hooda: Aryabhata- Life and Contribution, New Age International Publishers,1996.

2] Kripa Shankar Shukla, and K.V. Sarma: Aryabhatiya of Aryabhata, Indian National Science Academy, New Delhi, 1976.

3] Kripa Shankar Shukla: Aryabhatiya of Aryabhata, Indian National Science Academy, New Delhi, 1974.

4] S. N. Sen and A. K. Beg: Studies in Indian Mathematics and Astronomy, Indian National Science Academy, 1983.

5] Siddhant-Siromani: Internet Archive uploaded by public resource, 2017.

6] Lilavati of Bhaskaracharya: A Treatise of Mathematics of Vedic Tradition, Motilal Banaras Dass Publishing House, 2017.

7] S. K. Rao: Srinivasa Ramanujan, East-Wast Books, 1998.

8] B.C. Berndt & R.A. Rankin: Ramanujan-Essay and Surveys, American Mathematical Society, 2009.

9] C.N. Srinivasiengar : A History of Indian Mathematics, Asia Publishing House 1967.

Program: B. Sc.- II (Mathematics) Semester - III

Course Code / Subject: 126215 / Mathematics

The Vertical/ Type of Course: Minor / Theory 1

Course Name: Integral Calculus and Trigonometric Series

Total Number of Hours / Week: 2 Hrs.

Course Objectives: -

- To understand the methods for integrating irrational algebraic functions by rationalization and substitution. Also evaluating integral of trigonometric and exponential function by reduction formulae.
- To develop the ability to evaluate double and triple integrals. Also to explore and analyze classical trigonometric series expansion.

Unit	**Content**
Unit I	Integration of irrational algebraic functions. **(08 Hrs.)**
Unit II	Reduction formulae for $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \cot^n x\,dx$, $\int \sec^n x\,dx$, $\int \operatorname{cosec}^n x\,dx$, *and* $\int \sin^n x \cos^m x\,dx$. **(07 Hrs.)**
Unit III	Evaluation of Double integrations, Evaluation of Triple Integrations. **(08 Hrs.)**
Unit IV	Gregory series, Euler's series, Machin's series and Rutherford series. **(07 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1**: Simplify and manipulate irrational functions to facilitate their integration, making use of algebraic identities and substitutions. **CO2:** Apply reduction formulae. **CO3:** Understand the concept of double and Triple integration. **CO4:** Compute summation of trigonometric series.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Text Book of Integral Calculus and Trigonometric Series: V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari, A. P. Wasnik, A.P. Jenekar, S. P. Gaikwad, Dnyanpath Publication, Amravati, First edition 2025.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, A Text book of Differential and Integral Calculus: Dnyanpath Publication, Amravati, First Edition, 2022.
2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari: A Text book of Algebra and Trigonometry, Dnyanpath Publication, Amravati, First Edition, 2022.
3] T. M. Karade, J. N. Salunke, M. S. Bendre, Graduate Level Calculus, Sonu-Nilu, Publication, Nagpur.
4] T. M. Karade, J. N. Salunke, A. G. Deshmukh, M. S. Bendre, Lectures on Advanced Calculus, Sonu-Nilu, Publication, Nagpur.
5] Gorakh Prasad, Integral Calculus, Pothishala Pvt. Ltd., Allahabad, 1981.
6] Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd., Allahabad.
7] N. Piskunov, Differential and Integral Calculus, Peace publishers, Noscow.
8] Greenspan D., Introduction to Calculus, Harper and Row, 1968.
9] Ayres F.Jr., Calculus, Schaum's Outline series, McGRaw Hill, 1981.
10] Edwards J., Integral Calculus for Beginners, AITBS, Publishers and Distributors, 1994.

Program: B. Sc.- II (Mathematics) Semester - III

Course Code / Subject: 126216 / Mathematics

The Vertical/ Type of Course: Minor / Lab Course – 7

Course Name: Practical Based on Integral Calculus and Trigonometric Series **(**l26215)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- To provide practical experience in evaluating complex integrals, including irrational algebraic functions and application of reduction formulae, using manual and computational methods.
- To facilitate the numerical and symbolic exploration of trigonometric series, such as Gregory, Machin's, Rutheford, and Euler series, and to apply them for approximating values of π and other constants.

Course Outcomes:

After successful completion of this course students will able to:

CO1: Evaluate the integral by using reduction formulae.
CO2: Understand the concept of double integration.
CO3: Develop the ability to evaluate triple integral.
CO4: Learn various methods for finding the integrals.
CO5: Evaluate integrals by changing the order of integration.

Sr. No.	List of Practical's to be covered		No. of Examples
Practical Based on Integral Calculus and Trigonometric Series (126215)			
	Practical Based on Group A		
1	To find integration of type $\int \frac{dx}{\sqrt{Q}}$, where $Q = ax^2 + bx + c$.		03
2	To find integration of type $\int \frac{P_n(x)\,dx}{\sqrt{Q}}$, where $P_n(x) =$ polynomial in x of degree n.		03
3	To evaluate the integral by using reduction formulae.		03
4	To find the value of integration by using Walli's formula.		03
5	To find Area under curves by using integration		03
6	To find Work done by a force by using integration		03
	Practical Based on Group B		
7	To find the surface area of conic section by using integration.		03
8	To find the arc length of conic section by using integration.		03
9	To find the volume of a solid of revolution by using integration.		03
10	Evaluate the integral by changing the order of integration.		03
11	To evaluate the triple integral.		03
12	To find the sum of trigonometric series.		03
Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**	
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**	

Practical Book:

A Practical Book based on Integral Calculus and Trigonometric Series: V. A. Sharma, V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari, V. D. Jadhao, S. H. Shekh, M. G. Bhujade, R. R. Atram, R. P. Rewaskar, Dnyanpath Publications, Amravati, First edition 2025.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari: A Text book of Differential and Integral Calculus: Dnyanpath Publications, Amravati, First Edition, 2022.
2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari: A Text book of Algebra and Trigonometry, Dnyanpath Publication, Amravati, First Edition, 2022.
3] T. M. Karade, J. N. salunke, A. G. Deshmukh, M. S. Bendre: Lectures on Advanced Calculus, Sonu-Nilu, Publication, Nagpur.
4] Gorakh Prasad: Integral Calculus, Pothishala Pvt. Ltd., Allahabad, 1981.
5] Gorakh Prasad: Differential Calculus, Pothishala Pvt. Ltd., Allahabad.
6] N. Piskunov: Differential and Integral Calculus, Peace publishers, Noscow.
7] Greenspan D.: Introduction to Calculus, Harper and Row, 1968.
8] Edwards J.: Integral Calculus for Beginners, AITBS, Publishers and Distributors, 1994.

Program: B. Sc.- II (Mathematics) Semester- III

Course Code / Subject: 126217 / Mathematics

The Vertical/ Type of Course: Generic/ Open Elective / Theory 5

Course Name: Reasoning Ability

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To develop and enhance critical thinking, logical reasoning and problem-solving abilities in students.
- To equip students with a strong foundation in various logical and analytical reasoning techniques.

	Content
English	**Unit-I:** Missing Number, Number series, String based examples. **(07 Hrs.)** **Unit-II:** Cube and Cuboid, Counting Figures, Dice. **(08 Hrs.)** **Unit-III:** Clock and Calendar. **(07 Hrs.)** **Unit-IV:** Analogy and Similarity of numbers, Venn Diagram, Direction sense and Distance. **(08 Hrs.)**
Marathi	**यूनिट I:** अंक कोडे, संख्या मालिका, अक्षर-संख्या-प्रतीक मालिका. **(07 Hrs.)** **यूनिट II:** घन आणि घनाभ, आकृती मोजणी, पासा. **(08 Hrs.)** **यूनिट III:** घड्याळ आणि कॅलेंडर. **(07 Hrs.)** **यूनिट IV:** संख्यांची उपमा आणि साम्य, वेन आकृती, दिशा ज्ञान आणि अंतर. **(08 Hrs.)**
Hindi	**यूनिट I:** लुप्त संख्या, संख्या श्रृंखला, अक्षर-संख्या-प्रतीक श्रृंखला। **(07 Hrs.)** **यूनिट II:** घन और घनाभ, आकृतियों की गणना, पासा। **(08 Hrs.)** **यूनिट III:** घड़ी और कैलेंडर। **(07 Hrs.)** **यूनिट IV:** संख्याओं की समानता और उपमा, वेन आरेख, दिशा ज्ञान और दूरी। **(08 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** Understand and apply the fundamental properties of numbers to solve problems. **CO2:** Solve problems related to painting, cutting, folding, and unfolding of cubes and cuboids. **CO3:** Apply logical and numerical reasoning to solve complex clock and calendar-based questions. **CO4:** Strengthen analytical thinking by solving similarity-based questions using mathematical relationships. **CO5:** Develop logical reasoning and quantitative problem-solving skills for competitive exams and practical applications.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment)

	2. Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:
A Text Book of Reasoning Ability: V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari Y.S. Solanke, V. D. Jadhao, N. S. Bayaskar, S. D. Gajbhiye, N. V. Bhongade, Dnyanpath Publications, Amravati, First edition 2025.

Reference Books:
1] R. S. Aggarwal: Objective Arithmetic, S. Chand Publication, New Delhi.
2] R. S. Aggarwal: Quantitative Aptitude for Competitive Examinations, S. Chand Publication.
3] Rajesh Verma: Fast Track Objective Arithmetic, Arihant Publication (India) Ltd.
4] B. S. Grewal: Elementary and Higher Engineering Mathematics, Khanna Publishers.
5] S. L. Gulati: Objective Arithmetic, cosmos book hive (1 December 2016).
6] I. F. Sharygin: Problems in Plane and Solid Geometry, Mir Publishers Moscow.
7] Jeffrey Slater: Practical Business Math Procedures, McGraw Hill; 12th edition (16 February 2016)
8] Arun Sharma: Quantitative Aptitude, McGrow Hill.

Program: B.Sc. II (Mathematics) Semester – III

Course Code / Subject: **126218** / Mathematics

The Vertical/Type of Course: VSC (Vocational Skill Course) / Lab Course 8

Course Name: Mathematics for Information Technology

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- To develop foundational mathematical skill for information technology.
- To illustrate how fundamental mathematical structure (logic, sets, relations, functions, matrices, sequences) are directly applied in diverse computing domains.

Unit I	Logic and Boolean algebra for IT: Statements, Truth Tables, Logical Connectives, Quantifiers. AND, OR, NOT, XOR Operations, Logic Gates. Applications in Computer hardware and Programming. **(07 Hrs.)**
Unit II	Sets, relations and functions in Computing: Sets and Subsets, Operations on Sets, Cartesian Products, Relations, Functions and its types. Applications in Database Management Systems and Software Engineering. **(07 Hrs.)**
Unit III	Determinants and Matrices for IT: Determinants, Basics of Matrices, and Inverse of a Matrix, Eigenvalues and Eigenvectors. Applications in image processing and Computer Graphics. **(08 Hrs.)**
Unit 1V	Progressions and Sequences in IT: Introduction to Sequences and Progressions, Applications of arithmetic progression in Storage allocation databases. Applications of geometric progression in growth of data in networks like viral marketing and social media. **(08 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO 1: Analyze logical statements and construct truth tables using logical connectives and quantifiers.
CO 2: Apply Boolean algebra in designing and evaluating digital circuits and logic gates used in computer hardware and programming.
CO 3: Classify and evaluate functions, relations, and equivalence relations, and use them to design and implement data structures and relational models.
CO 4: Perform matrix operations, calculate determinants, inverses, eigenvalues, and eigenvectors.
CO 5: Interpret and apply arithmetic and geometric progressions to model and solve real-life IT problems like data propagation in networks and social media platforms.

Practical Book:

A Practical Book based on Mathematics for Information Technology: V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari,, S. J. Shingane, T. D. Nakade, S. J. Chavan, Y. U. Naner, Dnyanpath Publication, Amravati, First edition 2025.

Reference Books:

1] Kenneth H. Rosen**:** Discrete Mathematics and Its Applications**,** McGraw-Hill Education.
2] Gilbert Strang: Linear Algebra and Its Applications**,** Cengage Learning.
3] Bernard Kolman, Robert C. Busby, and Sharon Cutler Ross**:** Discrete Mathematical Structures, Pearson Education.
4] B. S. Grewal: Higher Engineering Mathematics**,** Khanna Publishers.

Sr. No.	**List of Practical's to be covered**
	Practical Based on Group A
1	To construct truth tables for compound logical statements using logical connectives.
2	To evaluate logical statements involving quantifiers using sample propositions.
3	To design and implement Boolean expressions using logic gates.
4	To write a program to compute the cartesian product of two finite sets & display the output as ordered pairs.
5	To create and visualize set operations using Venn diagram tools.
6	To Build a simple calculator using Logical Flow.
7	To design a 4-Bit Binary Counter using T Flip-Flops and control logic.
8	To design a half adder circuit using basic logic gates.
9	To design a 2-to-1 multiplexer circuit using logic gates.
10	To perform bitwise operations (AND, OR, XOR) in programming.
	Practical Based on Group B
1	To compute the determinants and inverses of matrices.
2	To transform a 2D Object using matrices.
3	To calculate area scaling using determinants.
4	To check invertibility to find inverse of matrix.
5	To calculate eigenvalues and eigenvectors of a 2×2 or 3×3 matrix and interpret their meaning in data transformation.
6	To construct a geometric progression model for data growth in social media or viral marketing.
7	To analyze a dataset showing user growth or revenue over time and fit an AP or GP to interpret the business mode.
8	To create a program to generate and visualize an arithmetic progression and apply it to database storage allocation.
9	To construct a geometric progression model with decay factor in viral marketing or social media growth and plot the trend.
10	To use arithmetic progressions to allocate storage blocks to sequential records in a database.
Internal Practical Assessment (50 Marks)	**1**.Practical Perform **– 30 Marks** (Perform Any one from group A and B, each carry **15 marks**) **2.** Practical Record**- 10 Marks** **3.** Viva voce **– 10 Marks**

Program	B. Sc. II (Mathematics) (Sem-III)
Type of Course	Field Project/Community Engagement Services **(FP/CES)-I**
Course Code	**126227**
Number of Credits	2
Total Hours per Week	4 Hrs**.**
Contact Hours	90 Hrs. / 60 Hrs.
Project Page Length	20 –30 pages
Max. Marks	**50**

Course Objectives	1. Develop an understanding of how mathematical concepts can be applied to real-world problems. 2. Gain hands-on experience in data collection, organization, and mathematical analysis. 3. Strengthen problem-solving skills using mathematical models and statistical tools. 4. Enhance abilities in logical reasoning, critical thinking, and interpretation of results**.** 5. Improve research, teamwork, and report-writing skills through field-based project work.
Course Outcomes	After successful completion of this course/project work, students will be able to: 1. Apply appropriate mathematical models to analyse real-life situations. 2. Collect, organize, and interpret data using mathematical/statistical techniques. 3. Demonstrate the use of technology (Excel, Python, MATLAB, etc.) for mathematical computation and visualization. 4. Present project findings effectively in written reports and oral presentations. 5. Work independently and collaboratively on field-based mathematical investigations**.**

Guidelines for Field Project (FP) and Community engagement services (CES):
As per NEP 2020, students of B Sc. II of Semester III and IV need to perform a Field Project (FP) and Community engagement services (CES) for two (2) credits with maximum of 50 Marks. For better knowledge about key principles with forms of CE, operational guidelines and implementation strategy please refer https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf .

The guidelines regarding the field project are as follows:

1. Prepare Field Project/CES project strictly as per the given structure.
2. Choose title and methodology of your FP/ CES project as per given suggested areas and services.
3. The title of FP/ CES project should be finalized in consultation with the project guide and Head of Department.
4. In order to prepare project proposal, start early and plan time for data collection.
5. Keep mathematical explanations simple and relevant to the title of project.
6. Use graphs and figures wherever possible for easy to explain the concept.
7. Avoid plagiarism, write the content in your own words and cite properly wherever necessary.
8. The project report should be of minimum of 20-30 pages.
9. The project report should be submitted to the department with the signatures of the guide and the Head of Department.
10. The poster/PPT presentation on project is compulsory and must be evaluated by Head of the department.

Structure of a Field Project (FP) and Community Engagement Service (CES)
The proposal of the Field Project (FP) and Community Engagement Service (CES) project should be prepared and presented according to the following structure.

Sr. No.	Section	No. of Pages	Contents / Description

1	Title Page	01	Project Title, Student Name, Roll No., Class, Semester, Institution, Guide's Name, Date of submission.
2	Certificate	01	Statement signed by student, Supervisor and Head of Department certifying authenticity of work.
3	Acknowledgement	01	Thanks to guide/HOD, institution, friends, and data sources.
4	Abstract	01	Brief summary: objectives, methods, key results, conclusion.
5	Introduction	03	Background of topic, motivation, importance, objectives of study.
6	Literature Review	03	Short overview of related studies, books, or research articles.
7	Theory	08	Mathematical Background: Explanation of formulas, models, or theorems used in the project.
8	Methodology	05	Field Work: How data was collected (survey, observation, census, secondary data), tools/ software used (Excel, Python, etc.)
9	Collected Data Analysis	03	Collected data in tables, graphs, charts; applying mathematical/statistical methods for analysis.
10	Results and Interpretation	02	Final calculated results, model fitting, graphs with explanation of real-world meaning.
11	Conclusions	01	Summary of findings, importance of results, limitations, scope for further work.
12	References / Bibliography	02	List of books, journals, websites referred (APA/IEEE format).
	Total Pages	**30**	

Various Areas for Field Projects in Mathematics and Methodologies:

Integrating Mathematics with Field Projects helps students to understand the real-world value of the subject. Some suggested areas for field projects in Mathematics and methodology in order to prepare the project proposal are as follows:

Sr. No.	Field Projects on Mathematics in	Methodology
1	Technology and Computing	Choose anyone methodology from among the following: 1. Survey Method 2. Observational Method 3. Experimental Method 4. Statistical Method 5. Comparative Method 6. Projective Method 7. Modeling Method
2	Artificial Intelligence and Data Science	
3	Economics and Finance	
4	Biological Sciences and Medicine	
5	Climate/ Weather Prediction	
6	Music and Visual Arts	
7	Politics and Election-Voting Process	
8	Social Medias and Sports	
9	Applied Sciences	
10	Survey Based Statistical Study	

Benefits of FP in Mathematics:

1. **Practical Application**: Students understand how mathematical concepts are applied in real-world situations.
2. **Problem-Solving Skills**: Enhances analytical and logical thinking through hands-on tasks.
3. **Community Connection**: Builds awareness of how mathematics can address social, economic, and local issues.
4. **Interdisciplinary Learning**: Encourages integration of mathematics with science, economics, technology, and daily life.
5. **Creativity & Innovation**: Inspires students to design models, surveys, and solutions using mathematics.
6. **Critical Thinking**: Promotes questioning, reasoning, and evaluation of mathematical outcomes.
7. **Collaboration**: Improves teamwork, communication, and peer learning during project activities.
8. **Skill Development**: Develops research, data collection, analysis, and presentation skills.
9. **Career Orientation**: Helps students connect mathematics with professional fields like data science, engineering, finance, and technology.

10. **Confidence Building** – Encourages independent learning and confidence in applying mathematics outside textbooks.

Various Community Engagement Services (CES) in Mathematics:
Linking Mathematics with Community Engagement that helps students to see the social relevance of the subject. Some suggested community engagement services in Mathematics are tabulated as follows. Students have to choose any one of the following community engagement services.

	Services/Activities	Description
1	Tutoring and Peer Support	Students provide free math tutoring for weaker school students in nearby villages and towns.
2	Math Literacy Camps	Students can organize workshops in nearby schools, communities to teach basic numeracy, mental arithmetic and problem-solving.
3	Financial Literacy Programs	Students can train community members as like farmers, vendors, women self-help groups etc. in budgeting, simple interest, compound interest and savings calculations.
4	Data Analysis for Local Issues	Students collect data on local topics as like water usage, traffic, school attendance, etc. and analyse using statistics.
5	Mathematics for Small Businesses	Students help to small shopkeepers, vendors in inventory control, profit-loss calculation, and pricing using simple mathematical methods.
6	Math and Technology Awareness Drives	Students demonstrate use of spreadsheets in Excel, basic coding, or mobile apps for calculations to community members.
7	Environmental and Social Survey	Students apply statistical methods to study pollution levels, waste management, energy usage, or health surveys in localities.
8	Math in Daily Life Campaigns	Students prepare posters, street plays, or videos showing applications of mathematics in cooking, shopping, travel, and construction.

Benefits of CES in Mathematics:

1. **Bridges Theory and Practice**: Students apply mathematical concepts to real-life community problems.
2. **Enhances Skills**: Improves problem-solving, analytical thinking, teamwork, and communication.
3. **Social Impact**: Promotes awareness of societal issues and the use of mathematics for solutions.
4. **Experiential Learning**: Provides hands-on exposure beyond classroom teaching.
5. **Career & Research Growth**: Prepares students for jobs, higher studies, and publications through practical projects.
6. **Civic Responsibility**: Develops empathy, responsibility, and leadership among students.
7. **Innovation & Creativity**: Encourages designing new models and solutions for community challenges.
8. **Collaboration & Networking**: Builds connections with schools, NGOs, industries, and local bodies.
9. **Confidence Building**: Strengthens presentation, decision-making, and leadership qualities.
10. **Social Relevance**: Shows how mathematics contributes to solving community and societal challenges

Distribution of Marks and the Scheme of FP/CES Project Evaluation (Internal Assessment)

Sr. No.	Component	Marks
1	Submission of FP or CES Project Proposal as per the structure	30
2	Report Writing and PPT Presentation	10
3	Viva-Voce / Oral Examination	10
	Total	**50**

UG Program (NEP) Semester IV

Program: B. Sc.- II (Mathematics) Semester - IV

Course Code/Subject: 126219 / Mathematics

The Vertical/Type of Course: Major / Theory- 5

Course Name: Ordinary Differential Equations

Total Number of Hours/Weeks: 2 Hrs.

Course Objectives:

- To equip students with the knowledge and skills to solve differential equations and apply algebraic techniques to model and analyze the real-world problems.
- To develop analytical and problem-solving skills in the students.

Unit	Content
Unit I	Formation of ordinary differential equation, degree and order of ordinary differential equation, homogeneous differential equation, linear differential equation, Bernoulli's equation, differential equations reducible to the linear form, exact differential equations. **(08 periods**)
Unit II	Differential equations of first order and higher degree, differential equations solvable for p, x and y. (**07 periods)**
Unit III	Linear differential equations with constant coefficients, complementary function of the differential equations, particular integral of the differential equations, homogeneous linear ordinary differential equations. **(08 periods)**
Unit IV	Second order differential equations, Wronskian, method of change of dependent and independent variable, variation of parameter. **(07 periods)**
Course Outcomes After successful completion of this course, students would be able to **CO1**. Solve first order differential equations using different techniques. **CO2**. Solve higher order differential equations. **CO3**. Calculate complementary function and particular integral of the second order differential equation. **CO4.** Describe the different methods to solve second order differential equations.	
Internal Assessment (20 Marks)	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review **(05 Marks)** **3.** Field Work/ Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Text Book of Ordinary Differential Equations: V. A. Sharma V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari, Dnyanpath Publication, Amravati, First edition 2025.

Reference Books:

1] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari: A Text book of, Ordinary Differential Equations, Dnyanpath Publication, Amravati, First Edition, 2022.

2] T. M. Karade, N. T. Karade: Ordinary Differential Equations, Sonu-Nilu. Nagpur, 2016.

3] Ayres F Jr.: Differential equations, Schaum's outline series, MacGraw Hill, 1981.

4] Coddington: An introduction of Ordinary Differential Equations, E. A. Prentice Hall of india, 1998.

5] Murray D. A.: Introductory course in Differential Equations, Orient Longman (India), 1967.

6] Piaggio HTS: Differential Equations, CBS Publishers & Distributors, Delhi, 1985.

7] Siminons G. F.: Differential Equations, Tata McGraw Hill, 1972.

8] A. R. Forsyth: A Treatise on Differential Equations, Macmillan and Co. Ltd. London.

9] H. K. Dass: Advanced Engineering Mathematics, S. Chand Publication, 2010.
10] B. S. Grewal: Higher Engineering Mathematics, Khanna Publisher, New Delhi, 2017.
11] Erwin, Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 1999.
12] Richard Bronson, Theory and Problems of Differential Equations, McGraw Hill Inc, 1973.

Program: B.Sc. II (Mathematics) Semester - IV

Course Code/Subject: 126220 / Mathematics

The Vertical/Type of Course: Major, Theory- 6

Course Name: Elements of Algebra

Total Number of Hours/Weeks: 2 Hrs.

Course Objectives:

- To introduce students to fundamental algebraic concepts, structures, and techniques, enabling them to solve equations, manipulate algebraic expressions, and apply algebraic methods to problem-solving.
- To build a strong foundation in students about algebraic reasoning and problem-solving skills.

Unit	Content
Unit I	Group: Definition of a group with examples, Properties of group, Subgroups, Cyclic group, Order of a generator of a cyclic group. **(08 Hrs**)
Unit II	Cosets and Normal subgroups: Cosets, Lagrange's theorem, Normal subgroups, Different Characterization of normal subgroups, Quotient group. (**07 Hrs)**
Unit III	Homomorphism and Isomorphism: Homomorphism, Homomorphic image, Kernel of Homomorphism, Isomorphism of a group, Fundamental theorem of homomorphism of a group, second isomorphism theorem, third isomorphism theorem. **(08 Hrs)**
Unit IV	Ring: Definition, examples and Properties of a ring (Commutative ring, ring with unity, zero divisor, without zero divisor), Subring, Characterization of ring, Integral domain, Field, Subfield, Prime field (Definition only) **(07 Hrs)**
Course Outcomes After successful completion of this course, students would be able to **CO1.** Learn the concept of Group, Subgroup and Cosets. **CO2.** Explain the significance of the notations of Cosets, Normal subgroups and Quotient group. **CO3.** Analyze different characterizations of normal subgroups. **CO4**. Learn the concept of Homomorphism & Isomorphism and its Theorem. **CO5.** Study the properties of Ring and Ideals and Integral domain.	
Internal Assessment (20 Marks)	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review **(05 Marks)** **3 .** Field Work/ Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Text Book of Elements of Algebra: V. A. Sharma G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari, Dnyanpath Publication, Amravati, First edition 2025.

Reference Books:

1] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari, N. S. Bayaskar, R. V. Kene, P. B. Deshmukh, M. C. Dhabe: A Text Book of Elements Algebra, Dnyanpath publication, Amravati, First edition 2023.
2] I. N. Herstein: Topic in Algebra, Wiley Eastern Ltd, New Delhi,1975.
3] N. Jocobson: Basic Algebra, Vol. I and II W. H. Freeman, Hindustan Publishing Co.,1980.

4] Shanti Narayan: A Text Book of Modern Abstract Algebra, S. Chand and Co. New Delhi.
5] P.B. Bhattacharya, S. K. Jain and S. R. Nagpal: Basic Abstract Algebra (IInd Edition) Cambridge University Indian Edition, 1997.
6] K. Hoffman and R. Kunze: Linear Algebra, IInd Edition Prentice Hall, Englewood Cliffs, New Jersey,1971.
7] S. K. Jain, A Gunawardhana and P. B. Bhattacharya: Basic Linear Algebra with MATLAB, Key College Publishing (Spinger-Verlag) 2001.
8] S. Kumaresan: Linear Algebra: A Geometric Approach, P Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
9] Vivek Sahai and Vikas Bisht: Algebra, Narosa Publishing House, 1997.
10] D. S. Malik, J. N. Mordeson and M. K. Sen: Fundamental Abstract Algebra, McGraw Hill International Edition, 1997.

Program: B. Sc.- II (Mathematics) Semester - IV

Course Code / Subject: **126229*** / Mathematics

The Vertical/ Type of Course: Major / Theory -7*

Course Name: Solid Coordinate Geometry

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- Understand and analyze the concepts of asymptotes and their role in curve behavior and to interpret geometric properties of curves using differential calculus techniques.
- To Understand the coordinate system and represent points and geometric objects in three-dimensional space and to apply analytical and vector methods to solve problems related to lines and planes in space geometry.
- Understand the definition and geometric interpretation of cones and cylinders in three-dimensional geometry and apply coordinate geometry techniques to represent and analyze conical and cylindrical surfaces.
- Develop problem-solving skills related to quadric surfaces in analytic geometry.

Unit	**Content**
Unit I	**Curves:** Asymptotes, Curvature, Radius of Curvature, Curvature at origin, Centre of curvature, Tests for concavity and convexity, Points of inflexion, Multiple point, Double point, Types and Nature of cusps, Tracing of curves in Cartesian and Polar forms. **(08 Hrs.)**
Unit II	**Planes:** Direction Cosines and Direction Ratios, Equation of Plane, Normal Form, Transform to the Normal Form, Plane Passing through Three Non-collinear Points, Intercept Form, Angle between Two Planes, Distance of a Point from a Plane, Distance between Parallel Planes, Two Sides of Planes, Bisector Planes, The plane through the intersection of two planes. **(07 Hrs.)**
Unit III	**Line:** Co-ordinates, Direction cosines of a line, Equation of lines, Angle between two lines, Angle between plane and a line, Condition for a line to lie in a plane, Coplanar lines, Condition for coplanarity of lines, The shortest distance between two lines, Length of the perpendicular from a point to a line, Relation between direction cosines and three mutual perpendicular lines. **(08 Hrs.)**
Unit IV	**Cones and Cylinders:** Definition, The equation of a cone with a guiding curve, cone with vertex and origin, right circular cone. Cylinder, equation of right circular cylinder. **(07 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** To sketch curves accurately using analytical and differential calculus techniques.	

CO2: To derive and use various forms of the equation of a plane, including normal and intercept forms. **CO3:** To solve geometrical problems in three-dimensional analytic geometry using vector and coordinate methods. **CO4:** To Develop spatial visualization and mathematical reasoning skills in three-dimensional geometry.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Textbook of Solid Coordinate Geometry: V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, V. D. Elkar, K. S. Wankhade, S. B. Tadam, S. A. Salve, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari : A Text book of Vector Analysis and Geometry, Dnyanpath Publication, Amravati, First Edition, 2022.
2] Shanti Narayan and Dr. P. K. Mittal: Differential Calculus by, S. Chand and Co. Ltd. Revised Edition 2012 (Reprint 2014).
3] Gorakh Prasad: Text book on Differential Calculus by, Pothishala Private limited Allahabad.
4] Ayres F : Calculus, Schaum's outline series, Mc Graw Hill, 1981.
5] Mac Millan: Differential calculus by Edwards, and Co. Ltd.
6] N. Bali: Golden Differential Calculus, Laxmi Publication Pvt Ltd.
7] Murray and R Spiegel :Theory and Problems on Advance Calculus by, Schaum Pub. Co. New York.
8] Edwards J : Differential Calculus for Beginners, MacMillan and Co.Ltd.,1963.
9] Greenspan D. : Introduction to Calculus, Harper and Row, 1968.
10] Shanti Narayan and Dr. P.K. Mittal, Analytical Solid Geometry, S. Chand Publication.
11] Gorakh Prasad, H.C. Gupta, Text Book on coordinate Geometry, Pothishala Publication.
12] Quiz Zameeruddin, Analytical Geometry of two and three dimensions, Narsoba Publication.
13] Murray R. Spiegel, Vector Analysis, Schaum Publishing Company, New York,1981.
14] N. Saran and S. N. Nigam, Introduction to vector Analysis Pothishala Pvt. Ltd. Allahabad.
15] Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Co. New Delhi.
16] R. J. T. Bell, Elementary Treatise on Co-ordinate Geometry of Three Dimensions, Macmillan India Ltd., 1994.
17] P. K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd., 1999.
18] N. Saran and R. S. Gupta, Analytical Geometry of three dimensions, Pothishala Pvt. Ltd. Allahabad, 2000.

Note:- ***To be implemented w.e.f. academic session 2026-27**

Program: B.Sc. II (Mathematics) Semester - IV

Course Code / Subject: **126221** / Mathematics

The Vertical/Type of Course: Major / Lab Course – 9

Course Name: Practical Based on Ordinary Differential Equations (126219) & Elements of Algebra (126220)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- To provide hands-on experience in solving differential equations and applying algebraic techniques to real-world problems using computational tools and software.

- To develop problem-solving skills, analytical thinking, algebraic reasoning and computational proficiency in the students.

Course Outcomes
After successful completion of this course, students would be able to
CO1. Solve first order differential equations using different techniques.
CO2. Solve higher order differential equations.
CO3. To find the orthogonal trajectories of the curve.
CO4. Describe the different methods to solve second order differential equations.
CO5. Define the Wronskian and explain its significance in the context of linear differential equations.
CO6. Calculate the total number of permutations for a given finite set
CO7. Apply group and Ring axioms to determine whether a set with a binary operation forms a group and ring.
CO8. Apply the ordinary differential equation for solving various physical, chemical and daily life problems.

Sr. No.	List of Practical's to be covered		No. of Examples
Practical Based on Ordinary Differential Equations (126219) & Elements of Algebra (126220)			
	Practical Based on Group A		
1	To solve the examples on Clairaut's form of differential Equation		03
2	To find orthogonal Trajectories of the curve.		03
3	To find the solution of second order differential equations.		03
4	To find the solution of second order differential equations by Normal form		03
5	To find solution of ordinary simultaneous differential equations.		03
6	To find Wronskian of the differential equation.		03
7	To solve the examples on Group.		03
8	To solve the examples on Ring.		03
	Practical Based on Group B		
9	To find the permutation of given set.		03
10	To apply ordinary differential equation for solving Electric circuit problem.		03
11	To apply ordinary differential equation for solving Steady state heat flow.		03
12	To apply ordinary differential equation for solving Radioactive decay.		03
13	To apply ordinary differential equation for carbon dating.		03
14	To apply ordinary differential equation for Newton's law of cooling.		03
15	To apply ordinary differential equation for finding compound interest.		03
Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**	
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**	

Practical Book:

A Practical Book of Ordinary Differential Equations and Elements of Algebra: V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari, R. V. Kene, P. R. Langade, A. R. Gupta, M. D. Netnaskar, G. D. Kanade, Dnyanpath Publication, Amravati, First edition 2025.

Reference Books:

1] V. A. Sharma V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari: A Text Book of Ordinary Differential Equations, Dnyanpath Publication, Amravati, First edition 2025.

2] V. A. Sharma G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari: A Text Book of Elements of Algebra, Dnyanpath Publication, Amravati, First edition 2025.
3] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari, N. S. Bayaskar, R. V. Kene, P. B. Deshmukh, M. C. Dhabe: A Text Book of Elements Algebra, Dnyanpath publication, Amravati, First edition 2023.
4] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari: A Text book of, Ordinary Differential Equations: Dnyanpath Publication, Amravati, First Edition, 2022.
5] Ayres F Jr.: Differential equations, Schaum's outline series, MacGraw Hill, 1981.
6] Coddington: An introduction of Ordinary Differential Equations, E. A. Prentice Hall of india, 1998.
7] T. M. Karade, N. T. Karade: Ordinary Differential Equation, Sonu-Nilu, Nagpur, 2016.
8] Murray D. A.: Introductory course in Differential Equations, Orient Longman (India), 1967.
9] Piaggio HTS: Differential Equations, CBS Publishers & Distributors, Delhi, 1985.
10] Siminons G. F.: Differential Equations, Tata McGraw Hill, 1972.
11] A. R. Forsyth: A Treatise on Differential Equations, Macmillan and Co. Ltd. London.
12] H. K. Dass: Advanced Engineering Mathematics, S. Chand Publication, 2010.
13] B. S. Grewal: Higher Engineering Mathematics, Khanna Publisher, New Delhi, 2017.
14] I. N. Herstein: Topic in Algebra, Wiley Eastern Ltd, New Delhi,1975.
15] N. Jocobson: Basic Algebra, Vol. I and II W. H. Freeman, Hindustan Publishing Co.,1980.
16] Shanti Narayan: A Text Book of Modern Abstract Algebra, S. Chand and Co. New Delhi.
17] K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
18] P.B. Bhattacharya, S. K. Jain and S. R. Nagpal: Basic Abstract Algebra (IInd Edition) Cambridge University Indian Edition, 1997.

Program: B.Sc. II (Mathematics) Semester – IV

Course Code/Subject: **126222** / Mathematics

The Vertical/Type of Course: Minor / Theory- 2

Course Name: Foundations of Integral and Differential Equations

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To understand and evaluate improper integrals, such as Beta and Gamma function including their properties, interrelations, and applications in solving definite integrals.
- To develop the ability to solve first and second order homogeneous differential equations, with a focus on both theoretical understanding and practical problem solving.

Unit	Content
Unit I	Improper integral (Definition only), Gamma function, Properties of Gamma function, Examples. **(07 Hrs.)**
Unit II	Beta function, Properties of Beta function, Relation between Gamma and Beta function, Examples, Jacobian **(08 Hrs.)**
Unit III	Formation of ordinary differential equation, degree and order of ordinary differential equation, homogeneous differential equation, linear differential equation, Bernoulli's equation, differential equations reducible to the linear form, exact differential equations. **(08 Hrs.**)
Unit IV	Linear differential equations with constant coefficients, complementary function of the differential equations, particular integral of the differential equations, homogeneous linear ordinary differential equations. **(07 Hrs.)**

Course Outcomes

After successful completion of this course, students would be able to

CO1. understand the concept of improper integral and Beta-Gamma function.
CO2. Understand the relation between Beta and Gamma function, and concept of Jacobian.
CO3. Solve first order differential equations using different techniques.
CO4. Calculate complementary function and particular integral of the second order differential equation.

Internal Assessment (20 Marks)	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3**. Field Work/ Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Text Book of Foundations of Integral and Differential Equations: V. A. Sharma V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari, Dnyanpath Publication, Amravati, First edition 2025.

Reference Books:

1] V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari: A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, Second edition 2024.
2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari ,Y. S. Solanke: A Text Book of Advanced Calculus, Dnyanpath publication, Amravati, First edition 2023.
3] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari: A Text book of, Ordinary Differential Equations, Dnyanpath Publication, Amravati, First Edition, 2022.
4] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, V. J. Gaikwad, R. M. Dhaigude: A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, First edition 2022.
5] T. M. Karade, N. T. Karade: Ordinary Differential Equations, Sonu-Nilu. Nagpur, 2016.
6] Gorakh Prasad: Integral Calculus, Pothishala Pvt. Ltd., Allahabad.
7] N. Piskunov : Differential a nd Integral Calculus, Peace publishers, Noscow.
8] Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.
9] S. C. Malik and Arora : Mathematical Analysis, Wiley Estern Ltd., New Delhi.
10] Murray R. Spiegel : Theory and Problems of Advanced Calculus, Schaum Outline Series.
11] Edwards J., Integral Calculus for Beginners, AITBS, Publishers and Distributors, 1994.

Program: B.Sc. II (Mathematics) Semester – IV

Course Code/Subject: **126223** / Mathematics

The Vertical/Type of Course: Minor / Lab Course 10

Course Name: Practical based on Foundations of Integral and Differential Equations (126222)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- To provide hands-on experience in evaluating improper integrals, using both analytical techniques and computational tools to understand convergence and approximation.
- To develop computational skills for solving homogeneous and linear ordinary differential equations, including step-by-step construction of complementary functions and particular integrals.

Course Outcomes

After successful completion of this course, students would be able to

CO1. Solve Proper and Improper integral.
CO2. Apply gamma and beta function to find integrals.
CO3. Understand the relation between beta and gamma function.
CO4. To understand the concept of Jacobian.
CO5. Solve first order differential equations using different techniques.
CO6. Solve higher order differential equations.
CO7. Describe the different methods to solve second order differential equations.
CO8. Learn the concept of Complementary function and particular integral.

Sr. No.	List of Practical's to be covered	No. of Examples
Practical Based on Foundations of Integral and Differential Equations (126222)		

Practical Based on Group A		
1	To solve some proper integrals	03
2	To solve some improper integrals	03
3	To find the integral by using gamma integral.	03
4	To evaluate the integral by using Beta function.	03
5	To evaluate some Beta function	03
6	To evaluate some Gamma function.	03
	Practical Based on Group B	
7	To solve the examples on relation between Beta and gamma function.	03
8	To find the Jacobian of given functions.	03
9	To solve some linear differential Equations.	03
10	To solve some Bernoulli's differential equations	03
11	To solve homogeneous ordinary differential equations.	03
12	To find Complementary function and particular integral of second order differential equations.	03
Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**

Practical Book:

A Practical Book of Foundations of Integral and Differential Equations: V. A. Sharma G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari, S.B. Tadam, V. M. Elkar, N. B. Nawale, A. M. Bagade, Dnyanpath Publication, Amravati, First edition 2025.

Reference Books:

1] V. A. Sharma V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari: A Text Book of Foundations of Integral and Differential Equations, Dnyanpath Publication, Amravati, First edition 2025.

2] V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari: A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, Second edition 2024.

3] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari ,Y. S. Solanke: A Text Book of Advanced Calculus, Dnyanpath publication, Amravati, First edition 2023.

4] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari: A Text book of, Ordinary Differential Equations, Dnyanpath Publication, Amravati, First Edition, 2022.

5] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, V. J. Gaikwad, R. M. Dhaigude: A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, First edition 2022.

6] T.M. Karade, J. N. Salunke, Maya S. Bendre, D.T. Solanke, C. S. Khodre, S. P. Gaikwad, N. B. Nawale: Advanced Calculus, SONU-NILU, Nagpur, 2023.

7] Gorakh Prasad: Integral Calculus, Pothishala Pvt. Ltd., Allahabad.

8] N. Piskunov : Differential and Integral Calculus, Peace publishers, Noscow.

9] Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.

10] S. C. Malik and Arora : Mathematical Analysis, Wiley Estern Ltd., New Delhi.

11] Murray R. Spiegel : Theory and Problems of Advanced Calculus, Schaum Outline Series.

12] Edwards J., Integral Calculus for Beginners, AITBS, Publishers and Distributors, 1994.

Program: B.Sc. II (Mathematics) Semester – IV

Course Code/Subject: **126224** / Mathematics

The Vertical/Type of Course: Generic/ Open Elective/ Theory 6

Course Name: Competitive Mathematics

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To develop and enhance quantitative aptitude and mathematical problem-solving skill in students.
- To equip students with the necessary skill to confidently approach and excel in quantitative aptitude sections.

	Content
English	**Unit I:** Problems on Numbers, Problems on Ages, Chain rule. **(08 Hrs.)** **Unit II:** Perimeter, Area, Volume and Surface Areas, Stock and Shares. **(7 Hrs.)** **Unit III:** Problems on Time and Work, Partnership. **(08 Hrs.)** **Unit IV:** Arithmetic and Geometric progression (A.P. and G.P.), Number series. **(07 Hrs.)**
Marathi	युनिट I: संख्यांवरील समस्या, वयावरील समस्या, श्रृंखला नियम. **(08 Hrs.)** युनिट II: परिघ, क्षेत्रफळ, घनफळ आणि पृष्ठफळ, स्टॉक आणि शेअर्स. **(07 Hrs.)** युनिट III: वेळ आणि काम, भागीदारी. **(08 Hrs.)** युनिट IV: अंकगणितीय आणि भूज्यामितीय श्रेणी (A.P. आणि G.P.), संख्या श्रृंखला. **(07 Hrs.)**
Hindi	यूनिट I: संख्याओं पर आधारित समस्याएँ, आयु पर आधारित समस्याएँ, श्रृंखला नियम। **(08 Hrs.)** यूनिट II: परिमाप, क्षेत्रफल, आयतन और सतह क्षेत्रफल, स्टॉक और शेयर। **(07 Hrs.)** यूनिट III: समय और कार्य, साझेदारी। **(08 Hrs.)** यूनिट IV: अंकगणितीय और ज्यामितीय श्रेणी (A.P. और G.P.), संख्या श्रृंखला। **(07 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** Understand and apply the fundamental properties of numbers to solve problems. **CO2:** Apply perimeter, volume and surface area concepts in solving real-world problems such as packaging, storage, and construction. **CO3:** Understand the concept of investment sharing in partnership. **CO4.** Apply A.P. concepts to solve real-life and theoretical problems. **CO5:** Develop logical reasoning and quantitative problem-solving skills for competitive exams and practical applications.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Assignment **(05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Textbook of Competitive Mathematics: V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari, Y. S. Solanke, V. D. Jadhao, S. D. Gajbhiye, N. V. Bhongade, Dnyanpath Publication, Amravati, First edition 2026.

Reference Book:

1] R. S. Aggarwal: Objective Arithmetic, S. Chand Publication, New Delhi.
2] R. S. Aggarwal: Quantitative Aptitude for Competitive Examinations, S. Chand Publication.
3] Rajesh Verma: Fast Track Objective Arithmetic, Arihant Publication (India) Ltd.
4] B. S. Grewal: Elementary and Higher Engineering Mathematics, Khanna Publishers.
5] S. L. Gulati: Objective Arithmetic, cosmos book hive (1 December 2016).
6] I. F. Sharygin: Problems in Plane and Solid Geometry, Mir Publishers Moscow.
7] Jeffrey Slater: Practical Business Math Procedures, McGraw Hill; 12th edition (16 February 2016)
8] Arun Sharma: Quantitative Aptitude, McGrow Hill.

Program: B. Sc.- II (Mathematics) Semester- IV

Course Code / Subject: 126225 / Mathematics

The Vertical/ Type of Course: VSC (Vocational Skill Course) / Lab Course-ll

Course Name: Business Calculus

Total Number of Hours/Week: 4 Hrs.

Course Objectives:

- To equip students with strong foundational understanding and practical application of differential and integral calculus for informed business decision-making and analysis.
- To equip students with a foundational understanding of calculus and its direct application in business and economics.

Unit	**Content**
Unit I	Functions, Limits, and Continuity: Definition and types of functions as Linear, Quadratic, Exponential, Logarithmic. Domain and range of business functions, Limit and its Basic concepts, Methods of evaluation, Continuity of functions and its significance in business applications. **(07 Hrs.)**
Unit II	Differentiation and Business Applications: Definition and rules of differentiation Marginal analysis in business: Marginal Cost, Marginal Revenue, Marginal Profit. Elasticity of demand and its economic significance **(07 Hrs.)**
Unit III	Maxima and Minima in Business Decision making: First and second derivative tests. Optimization in business: Profit maximization, Cost minimization, Revenue maximization, Applications in economic decision making. **(08 Hrs.)**
Unit IV	Integration and Business Applications: Basic integration rules and techniques. Definite and indefinite integrals. Applications in business: Consumer surplus, Producer surplus, Total revenue and cost functions. **(08 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO 1: Evaluate limits and examine the continuity of functions.
CO 2: Interpret cost, revenue, and profit functions relevant to business operations.
CO 3: Apply rules of differentiation to analyze marginal functions such as marginal cost, revenue, and profit in business decision-making.
CO 4: Calculate and interpret elasticity of demand, and evaluate its impact on pricing and revenue decisions.
CO 5: Apply first and second derivative tests to determine maxima and minima, optimizing profit, cost, and revenue functions in various business scenarios.
CO 6: Integrate basic and complex functions, using definite and indefinite integrals to compute consumer surplus, producer surplus, and total cost and revenue.

Practical Book:

A Practical Book of Business Calculus: V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, M. C. Dhabe, S. H. Shekh, C. S. Khodre, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] Ian Jacques**:** Mathematics for Economics and Business**,** Pearson Education.
2] Qazi Zameer Uddin, Vijay K. Khanna, S.K. Bhambri**:** Business Mathematics, Vikas Publishing House.
3] Raymond A. Barnett, Michael R. Ziegler, Karl E. Byleen: Mathematics for Business, Economics, Life Sciences, and Social Sciences**,** Pearson Education.
4] Shanti Narayan & P.K. Mittal**:** Differential and Integral Calculus**,** S. Chand Publications.

Sr. No.	**List of Practical's to be covered**
Practical Based on Group A	
1	To explore continuity and limits in profit function.
2	To study cost analysis using a quadratic function.

3	To analyze business revenue with a linear function.
4	To find marginal cost and marginal revenue using derivatives.
5	To solve business math problem, using product, quotient, and chain rule.
6	To calculate and understanding the price elasticity of demand using derivatives.
7	To calculate consumer and producer surplus using definite integrals.
Practical Based on Group B	
1	To maximize profit and minimize the cost using derivatives in business.
2	To find the best production level for maximum revenue using calculus.
3	To evaluate definite and indefinite integrals in business models.
4	To apply first and second derivative tests in order to optimize business profits.
5	To make smart pricing decisions in business using derivatives.
6	To determine total revenue and total cost in business using integration.
7	To apply basic integration rules to solve business accumulation problems.
Internal Practical Assessment **(50 Marks)**	**1.** Practical Perform – **30 Marks** (Perform any one from group A and B, each carry **15 marks**) **2.** Practical Record- **10 Marks** **3.** Viva voce– **10 Marks**

Program: B.Sc. II (Mathematics) Semester – IV

Course Code / Subject: **126226**# / Mathematics

The Vertical/Type of Course: **SEC / Lab Course 12**#

Course Name: Practical based on Equation Editor #

Total Number of Hours/Week: 4 Hrs.

Course Objectives:

- To effectively create, format and manage mathematical content within Microsoft world document.
- To provide extensive hands-on experience through practical exercises and a culminating project, allowing students to apply their learned skills to real world scenarios in mathematics.

Unit I	**Introduction to MS Equation Editor:** Overview of MS equation editor, accessing and enabling equation editor in MS Word**,** understanding the equation editor interface**,** basic mathematical symbols and notations**,** typing and formatting simple equations**,** shortcut keys and customization.
Unit II	**Advanced Mathematical Expressions:** Fractions, subscripts, and superscripts, Greek letters and special mathematical symbols**,** matrices and determinants**,** limits, summations, and integrals, creating and formatting complex equations, aligning and spacing equations properly.
Unit III	**Applications in Scientific and Technical Writing:** Using MS equation editor for research papers and reports**,** embedding equations in word documents, power point, and excel**,** customizing fonts and styles for professional documents**,** exporting and printing equations**,** common errors and troubleshooting in equation editor.
Unit 1V	**Hands-on Practice and Project Studies:** practical exercises on mathematical and scientific equations**,** creating equations for physics, engineering, and mathematics**,** formatting equations for academic journals**,** best practices for writing mathematical documents**,** project: preparing a document with complex equations.

Course Outcomes:

After successful completion of this course students will able to:

CO 1: Access and use the MS Equation Editor for typing and formatting simple equations.

CO 2: Create and format complex mathematical expressions including matrices, integrals, and symbols.

CO3: Apply the Equation Editor in research papers, presentations, and technical documents.
CO4: Practice creating discipline-specific equations for physics, engineering, and mathematics.
CO 5: Prepare a professional document with complex equations demonstrating best practices.

Practical Book:

A Practical book of Equation Editor: V. A. Sharma, V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari, S. V. Gore, P. R. Suruse, N. R. Ghungarwar, M. P. Shende, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] Joan Lambert: Microsoft Word 2019 Step by Step, Microsoft Press, One Microsoft Way, Redmond, WA 98052, USA,2019.
2] Leo Finkelstein: Technical Writing for Engineers & Scientists, McGraw Hill, 2 Penn Plaza, New York, NY 10121, USA,2007.
3] Faithe Wempen: Word 2016 In Depth, Que Publishing, 800 East 96th Street, Indianapolis, IN 46240, USA 2015.

Sr. No.	**List of Practical's to be covered**
	Practical Based on Group A
1	To Access and Enable MS Equation Editor in MS Word.
2	To Insert the Basic Mathematical Symbols in document (operators, equalities, and inequalities).
3	To Prepare document using Typing & Formatting Simple Equations (e.g., $ax + b = 0, px^2 + qx + r = 13\ etc.$).
4	To apply shortcut keys for Quick Equation Editing.
5	To format equations (changing font size, style, and colour).
6	To work with fractions (proper, improper, and mixed fractions).
7	To prepare expressions using subscripts and superscripts (e.g.,$H_2O, T_r^p, e^{-i\omega t}$,).
8	To insert Greek Letters and special symbols (e.g. $\alpha, \delta, \epsilon, \psi, \sigma, \mathcal{M}, \mathcal{R}, \wp\ etc.$)
9	To create and format matrices (*2×2, 3×3 Matrices*).
10	To write summations and integrals. ($\int x\ dx$, $\oint_1^2 x\ dx$, $\sum x$ *type* notations).
	Practical Based on Group B
1	To prepare mathematical problem using limit expressions. (e.g., $\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n$, $\max_{0\le x\le 1} xe^{-x^2}\ \ etc.$).
2	To write differentiation and partial derivatives. ($\frac{dy}{dx}, \frac{\Delta y}{\Delta x}, \frac{\partial y}{\partial x}, \frac{\delta y}{\delta x}\ etc.$).
3	To write set notations and logic symbols (union, intersection, subset, logical operators).
4	To insert and align equations in MS Word.
5	To embedding equations in Power Point and Excel
6	To format equations for Research papers (styling and alignment).
7	To convert equations to images for presentations.
8	To prepare document using accents $(e.g. \bar{\bar{a}},\ \bar{\bar{R}}\ , \ddot{a}\ \ etc.)$
9	To create and format equations for Physics & Engineering (Maxwell's equations, Ohm's law)
10	To prepare a project/ scientific document with Complex Equations.
Internal Practical Assessment (50 Marks)	**1.** Practical Perform – **30 Marks** (Perform Any one from group A and B, each carry **15 marks**) **2.** Practical Record- **10 Marks** **3.** Viva voce – **10 Marks**

Note:- **# - Only applicable up to academic session 2025-26**

Program	B. Sc. II (Mathematics) (Sem-IV)
Type of Course	Field Project/Community Engagement Services **(FP/CES)-II**
Course Code	**126228**
Number of Credits	2
Total Hours per Week	4 Hrs**.**
Contact Hours	90 Hrs. / 60 Hrs.
Project Page Length	20 –30 pages
Max. Marks	**50**

Course Objectives	1. Develop an understanding of how mathematical concepts can be applied to real-world problems. 2. Gain hands-on experience in data collection, organization, and mathematical analysis. 3. Strengthen problem-solving skills using mathematical models and statistical tools. 4. Enhance abilities in logical reasoning, critical thinking, and interpretation of results**.** 5. Improve research, teamwork, and report-writing skills through field-based project work.
Course Outcomes	After successful completion of this course/project work, students will be able to: 1. Apply appropriate mathematical models to analyse real-life situations. 2. Collect, organize, and interpret data using mathematical/statistical techniques. 3. Demonstrate the use of technology (Excel, Python, MATLAB, etc.) for mathematical computation and visualization. 4. Present project findings effectively in written reports and oral presentations. 5. Work independently and collaboratively on field-based mathematical investigations**.**

Guidelines for Field Project (FP) and Community engagement services (CES):
As per NEP 2020, students of B Sc. II of Semester III and IV need to perform a Field Project (FP) and Community engagement services (CES) for two (2) credits with maximum of 50 Marks. For better knowledge about key principles with forms of CE, operational guidelines and implementation strategy please refer https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf .

The guidelines regarding the field project are as follows:

1. Prepare Field Project/CES project strictly as per the given structure.
2. Choose title and methodology of your FP/ CES project as per given suggested areas and services.
3. The title of FP/ CES project should be finalized in consultation with the project guide and Head of Department.
4. In order to prepare project proposal, start early and plan time for data collection.
5. Keep mathematical explanations simple and relevant to the title of project.
6. Use graphs and figures wherever possible for easy to explain the concept.
7. Avoid plagiarism, write the content in your own words and cite properly wherever necessary.
8. The project report should be of minimum of 20-30 pages.
9. The project report should be submitted to the department with the signatures of the guide and the Head of Department.
10. The poster/PPT presentation on project is compulsory and must be evaluated by Head of the department.

Structure of a Field Project (FP) and Community Engagement Service (CES)
The proposal of the Field Project (FP) and Community Engagement Service (CES) project should be prepared and presented according to the following structure.

Sr. No.	Section	No. of Pages	Contents / Description

1	Title Page	01	Project Title, Student Name, Roll No., Class, Semester, Institution, Guide's Name, Date of submission
2	Certificate	01	Statement signed by student, Supervisor and Head of Department certifying authenticity of work
3	Acknowledgement	01	Thanks to guide/HOD, institution, friends, and data sources
4	Abstract	01	Brief summary: objectives, methods, key results, conclusion
5	Introduction	03	Background of topic, motivation, importance, objectives of study
6	Literature Review	03	Short overview of related studies, books, or research articles.
7	Theory	08	Mathematical Background: Explanation of formulas, models, or theorems used in the project.
8	Methodology	05	Field Work: How data was collected (survey, observation, census, secondary data), tools/ software used (Excel, Python, etc.)
9	Collected Data Analysis	03	Collected data in tables, graphs, charts; applying mathematical/statistical methods for analysis.
10	Results and Interpretation	02	Final calculated results, model fitting, graphs with explanation of real-world meaning
11	Conclusions	01	Summary of findings, importance of results, limitations, scope for further work
12	References / Bibliography	02	List of books, journals, websites referred (APA/IEEE format)
	Total Pages	**30**	

Various Areas for Field Projects in Mathematics and Methodologies:

Integrating Mathematics with Field Projects helps students to understand the real-world value of the subject. Some suggested areas for field projects in Mathematics and methodology in order to prepare the project proposal are as follows:

Sr. No.	Field Projects on Mathematics in	Methodology
1	Technology and Computing	Choose anyone methodology from among the following: 1. Survey Method 2. Observational Method 3. Experimental Method 4. Statistical Method 5. Comparative Method 6. Projective Method 7. Modeling Method
2	Artificial Intelligence and Data Science	
3	Economics and Finance	
4	Biological Sciences and Medicine	
5	Climate/ Weather Prediction	
6	Music and Visual Arts	
7	Politics and Election-Voting Process	
8	Social Medias and Sports	
9	Applied Sciences	
10	Survey Based Statistical Study	

Benefits of FP in Mathematics:

1. **Practical Application**: Students understand how mathematical concepts are applied in real-world situations.
2. **Problem-Solving Skills**: Enhances analytical and logical thinking through hands-on tasks.
3. **Community Connection**: Builds awareness of how mathematics can address social, economic, and local issues.
4. **Interdisciplinary Learning**: Encourages integration of mathematics with science, economics, technology, and daily life.
5. **Creativity & Innovation**: Inspires students to design models, surveys, and solutions using mathematics.
6. **Critical Thinking**: Promotes questioning, reasoning, and evaluation of mathematical outcomes.
7. **Collaboration**: Improves teamwork, communication, and peer learning during project activities.
8. **Skill Development**: Develops research, data collection, analysis, and presentation skills.
9. **Career Orientation**: Helps students connect mathematics with professional fields like data science, engineering, finance, and technology.

10. **Confidence Building** – Encourages independent learning and confidence in applying mathematics outside textbooks.

Various Community Engagement Services (CES) in Mathematics:
Linking Mathematics with Community Engagement that helps students to see the social relevance of the subject. Some suggested community engagement services in Mathematics are tabulated as follows. Students have to choose any one of the following community engagement services.

	Services/Activities	Description
1	Tutoring and Peer Support	Students provide free math tutoring for weaker school students in nearby villages and towns.
2	Math Literacy Camps	Students can organize workshops in nearby schools, communities to teach basic numeracy, mental arithmetic and problem-solving.
3	Financial Literacy Programs	Students can train community members as like farmers, vendors, women self-help groups etc. in budgeting, simple interest, compound interest and savings calculations.
4	Data Analysis for Local Issues	Students collect data on local topics as like water usage, traffic, school attendance, etc. and analyse using statistics.
5	Mathematics for Small Businesses	Students help to small shopkeepers, vendors in inventory control, profit-loss calculation, and pricing using simple mathematical methods.
6	Math and Technology Awareness Drives	Students demonstrate use of spreadsheets in Excel, basic coding, or mobile apps for calculations to community members.
7	Environmental and Social Survey	Students apply statistical methods to study pollution levels, waste management, energy usage, or health surveys in localities.
8	Math in Daily Life Campaigns	Students prepare posters, street plays, or videos showing applications of mathematics in cooking, shopping, travel, and construction.

Benefits of CES in Mathematics:

1. **Bridges Theory and Practice**: Students apply mathematical concepts to real-life community problems.
2. **Enhances Skills**: Improves problem-solving, analytical thinking, teamwork, and communication.
3. **Social Impact**: Promotes awareness of societal issues and the use of mathematics for solutions.
4. **Experiential Learning**: Provides hands-on exposure beyond classroom teaching.
5. **Career & Research Growth**: Prepares students for jobs, higher studies, and publications through practical projects.
6. **Civic Responsibility**: Develops empathy, responsibility, and leadership among students.
7. **Innovation & Creativity**: Encourages designing new models and solutions for community challenges.
8. **Collaboration & Networking**: Builds connections with schools, NGOs, industries, and local bodies.
9. **Confidence Building**: Strengthens presentation, decision-making, and leadership qualities.
10. **Social Relevance**: Shows how mathematics contributes to solving community and societal challenges

Distribution of Marks and the Scheme of FP/CES Project Evaluation (Internal Assessment)

Sr. No.	**Component**	**Marks**
1	Submission of FP or CES Project Proposal as per the structure	30
2	Report Writing and PPT Presentation	10
3	Viva-Voce / Oral Examination	10
	Total	**50**

Examination, Evaluation and Assessment Scheme

Vertical No.	The Vertical	Mode of Examination, Evaluation & Assessment	Theory				Theory (Total)		Practical				Practical (Total)	
			External		Internal				External		Internal			
			Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
a	Major	External & Internal	**30**	**9**	**20**	**6**	**50**	**20**	**25**	**10**	**25**	**10**	**50**	**20**
b	Minor		**30**	**9**	**20**	**6**	**50**	**20**	**25**	**10**	**25**	**10**	**50**	**20**
c	Generic/ Open Elective	Internal	--	--	**50**	**20**	**50**	**20**	--	--	--	--	--	--
d	VSC	Internal	--	--	--	--	--	--	--	--	**50**	**20**	**50**	**20**
	SEC	Internal	--	--	--	--	--	--	--	--	**50**	**20**	**50**	**20**
e	AEC (Eng. & One MIL Composite)	Internal	--	--	**50**	**20**	**50**	**20**	--	--	--	--	--	--
	IKS (Generic)	Internal	--	--	**50**	**20**	**50**	**20**	--	--	--	--	--	--
	VEC	Internal	--	--	--	--	--	--	--	--	--	--	--	--
f	Internship/ Apprenticeship FP/CEP CC	Internal	Assessment of these verticals shall be based on various activities/practices. The evaluation/assessment shall be done by appointing external examiner by principal from Industry/Organization/Academia. The mentor faculty shall be the internal examiner. It shall be evaluated by giving maximum 50 marks per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately.											

Appendix-A

INSTRUCTIONS FOR THE PAPER SETTERS
w.e.f. 2025-26
Subject: Mathematics

External University Examination

Sr. No	Program	Marks of theory paper	Internal Marks	Total	Instructions
1	UG – NEP (Mathematics) Major/Minor/IKS/Generic/ Open Elective	30	20	50	Total Units: 04 **(Two units for 08 Marks and Two units for 07 Marks)**
	SEM III AND SEM IV				**Paper setting for 08 Marks:** Question 1. a) 04 Marks OR b) 04 Marks Question 1. c) 04 Marks OR d) 04 Marks **Paper setting for 07 Marks:** Question 2. a) 04 Marks OR b) 04 Marks Question 2. c) 03 Marks OR d) 03Marks

Note: For the subject Mathematics, the strength of the batch of the practical for UG classes shall be of 16 students with an addition of 10% with the permission of Honourable Vice Chancellor. (As per NEP-2020 Scheme of SGBAU, Amravati, A-1686).

Model Question Paper

Major/Minor

B.Sc. (Part II) Semester III (NEP) Examination

Course Code: 126212

Major Theory – 4

Advanced Calculus

Time: 2 Hours **Maximum Marks: 30**

Note: 1. In each unit solve (a) or (b) and (c) or (d).

UNIT I

1. a) If the limit of function of two variable $f(x,y)$ *as* $(x,y)\to(a,b)$ exists, then prove that it is unique. **4**

OR

b) Prove that $\lim\limits_{(x,y)\to(4,-1)}(3x-2y)=14$ by using $\varepsilon-\delta$ definition of a limit of function of two variables. **4**

c) Show that the function $f(x,y)=\begin{cases}x^2+2y, & (x,y)\neq(1,2)\\ 0 & (x,y)=(1,2)\end{cases}$ has a removable discontinuity at (1,2). **4**

OR

d) Expand x^3+y^3-3xy in powers of $(x-2)$ *and* $(y-3)$. **4**

UNIT II

2. a) Define the following terms:

i) Local Maxima

(ii) Local Minima

(iii) Extremum

(iv) Critical Point **4**

OR

b) Find all the stationary point of the function $x^3+3xy^2-15x^2-15y^2+72x.$ Examining whether they are maxima or minima. **4**

c) Find the minimum value of $f=xy+\frac{q^3}{x}+\frac{q^3}{y}$ **3**

OR

d) If $x=r\sin\theta\cdot\cos\phi,\quad y=r\sin\theta\cdot\sin\phi,\ z=r\cos\theta$ find $\frac{\partial(x,y,z)}{\partial(r,\theta,\phi)}$ **3**

UNIT III

3. a) Define Limit of a sequence. Using the definition of limit, show that $\lim\limits_{n\to\infty}\frac{n-10}{2n+3}=\frac{1}{2}$ **4**

OR

b) Prove that the limit of a sequence, if it exists, is unique. **4**

c) Define Geometric Sequence and prove that every convergent sequence is bounded but the converse is not true. i.e. A bounded sequence may not be convergent. **4**

OR

d) The term of a sequence $\{s_n\}$ are as follows:

$s_1=0.2,\ s_2=0.22,\ s_3=0.222,\ldots\ldots\ldots\ldots,\ s_n=0.2222\ldots\ldots.$

Show that the sequence is monotonic increasing and bounded above. Find its limit. **4**

UNIT IV

4. a) Prove that a geometric series $\sum\limits_{n=1}^{\infty}r^{n-1},\ n\in N$ converges to $\frac{1}{1-r}$ *for* $|r|<1$ and diverges for $|r|\geq 1$. **4**

OR

b) Define harmonic series and prove that the harmonic series $\sum_{n=1}^{\infty}\frac{1}{n}$ is divergent. **1+3**

c) Test the convergence of series $\sum_{n=1}^{\infty}\frac{3^n}{4^n+4}$ **3**

OR

d) Test the convergence of the series $\sum_{n=1}^{\infty}\frac{3n^2+6n+1}{11n^2-n+4}$. **3**

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Sant Gadge Baba Amravati University, Amravati

Syllabus for B.Sc. III (Mathematics) Sem V & Sem VI (NEP)

Session 2026-27

Syllabus Prescribed from the year 2026-27, UG Program (NEP) Semester V

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: **126230** / Mathematics

The Vertical/ Type of Course: Major / Theory -8

Course Name: Mathematical Analysis

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- Students should be able to find the fixed points and the cross-ratio of given Möbius transformations. Student should also identify the function is analytic or not.
- To learn and apply conditions for Riemann integrability, including the necessary and sufficient criterion that the difference between the upper and lower sums can be made arbitrarily small.

Unit	**Content**
Unit I	Analytic function: Continuity and differentiability of complex function, Analytic function, Cauchy-Riemann equations, Harmonic and conjugate functions, Milne-Thomson method. **(08 Hrs.)**
Unit II	Transformation: Elementary function, Mapping by elementary function, Mobius transformation, Fixed point, Cross ratio, Inverse and critical points, Conformal mapping. (**07 Hrs.)**
Unit III	Riemann Integral: Integrability of continuous and monotonic functions, The fundamental theorem of integral calculus, Mean value theorem of integral calculus. **(08 Hrs.)**
Unit IV	Metric spaces: Definition and examples of metric spaces, Neighbourhood, Limit point, Interior point, Open and Close sets, Cauchy sequences. **(07 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** To learn Analytic function and Harmonic function. **CO2:** To understand Mobius transformation. **CO3:** To understand fundamental theorem of integral calculus. **CO4:** To understand metric space, open and closed sets.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Textbook of Mathematical Analysis: V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, R. M. Dhaigude, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari: A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, Second edition 2024.

2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, V. J. Gaikwad, R. M. Dhaigude : A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, First edition 2022.
3] R. R. Goldberg: Methods of Real Analysis, Oxford IBH publishing Co. New Delhi, 1970.
4] Walter Rudin: Principles of Mathematical Analysis, International student's edition (Third edition)
5] T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.,
6] S. Lang : Undergraduate Analysis, Springer-Verlag New York, 1983.
7] D. Somasundaram & B. Choudhari : A First Course in Mathematical Analysis, New Delhi. 1997.
8] Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.
9] P. K. Jain & S. K. Kaushik : An Introduction to Real Analysis, S. Chand & Co. New Delhi, 2000.
10] R. V. Churchiln and J.W.Brown, Complex Variables and Applications, 5th Edition, McGraw Hill, New York, 1990.
11] Mark J Ablowitz and : A.S. Fokas, Complex Variable Introduction and Application, Cambridge University Press, South Asian Edition, 1998.
12] Shanti Narayan: Theory of functions of Complex Variable, S. Chand and Co. New Delhi.
13] E.T. Coption, : Metric Spaces, Cambridge University Press ,1968.
14] P.K. Jain and K. Ahmed, : Metric Spaces, Narosa Publishing House, New Delhi 1996.
15] G. F. Simmons : Introduction to Topology and Modern Analysis, McGraw Hill, New York,1963. 16] Murray R. Spiegel : Theory and Problems of Advanced Calculus, Schaum Outline Series.
17] S. C. Malik and Arora : Mathematical Analysis, Wiley Estern Ltd., New Delhi.

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: **126231** / Mathematics

The Vertical/ Type of Course: Major / Theory -9

Course Name: Partial Differential Equations

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To understand applications of PDEs in physics, engineering, heat flow, wave motion and fluid dynamics etc. also to interpret mathematical solutions in context of physical problems.
- To understand how variational principles apply to Hamilton's principle, geodesics, brachistochrone problem, etc. and to relate variational techniques to real-world physical systems.

Unit	Content
Unit I	First Order PDE: Formation of PDE, Partial Differential equation of the first order, Total Differential Equation (Pfaffian), Lagrange's method, Some special type of equations which can be solved easily by methods other than the Lagrange's method. **(07 Hrs.)**
Unit II	Second Order PDE: Compatible Differential equation, Charpit's general method of solutions, Partial Differential equation of second and higher order, Homogeneous and non-homogenous equation with constant coefficients. (**08 Hrs.)**
Unit III	Calculus of Variation: Functional, Continuity of functional, variational problems with fixed boundaries, Extremum of a functional. **(07 Hrs.)**
Unit IV	Method of Separation of variables: Method of separation of variables for wave equations and heat equations in one dimension. **(08 Hrs.)**

Course Outcomes:	
After successful completion of this course students will able to: **CO1**: Learn to evaluate partial differential equations, solution of some special type of equations. **CO2:** Learn to solve methods of partial differential equation of second and higher order. **CO3:** Students will be familiar with techniques of Calculus of variations. **CO4:** Recognize various methods of separation of variables.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Textbook of Partial Differential Equations: V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, S. R. Kumbhare, T. D. Nakade, S. H. Shaikh, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, S. R. Kumbhare, T. D. Nakade, S. H. Shaikh: A Text Book of Partial Differential Equation, Dnyanpath publication, Amravati, First Edition 2023.

2] Murray D.A.: Introductory course in Differential Equations, Orient Longman (India), 1967.

3] Erwin, Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 1999.

4] Piaggio HTS: Differential Equations, CBS Publishers &Distributors, Delhi, 1985.

5] Siminons G.F. : Differential Equations, Tata McGraw Hill, 1972.

6] A.R. Forsyth. A Treatise on Differential Equations. Macmillan and Co. Ltd. London.

7] Ian N., Sneddon, Elements of Partial Differential Equations. McGraw-Hill Book Company, 1988.

8] Jane Cronin. Differential equations, Marcel Dekker, 1994.

9] Frnak Ayres. Theory and Problems of Differential Equations. McGraw Hill Book Company, 1972.

10] Richard Bronson, Theory and Problems of Differential Equations, McGraw Hill Inc, 1973.

11] A. S. Gupta: Calculus of Variations with Applications, Prentice-Hall of India, 1997.

12] I. M. Gelfand and S. V. Fomin: Calculus of Variations, Prentice-Hill Englewood Cliffs (New Jersey), 1963.

13] A. S. Gupta: Calculus of Variations with Applications, Prentice-Hall of India, 1997.

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: **126232** / Mathematics

The Vertical/ Type of Course: Major / Theory -10

Course Name: Mathematical Methods

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To understand the concept of Fourier Series and its importance in representing periodic functions. Also to develop Fourier Series expansions and it apply to practical mathematical and engineering problems.
- To apply recurrence formulas for solving boundary value problems and building higher-degree polynomials. Also to understand how recurrence helps compute higher-order functions efficiently.

Unit	Content
Unit I	Fourier Series: Introduction, Periodic functions, Dirichlet's condition, Even & Odd functions, Determination of Fourier Coefficients, Fourier Series for even and odd function. Examples. **(08 Hrs.)**

Unit II	Half Range Fourier Series: Construction of Half range Sine Series, Construction of Half range Cosine Series. Parseval's identity (statement only), Examples. **(07 Hrs.)**
Unit III	Legendre's equation: Legendre's polynomials, generating function of $P_n(x)$, recurrence formulae for $P_n(x)$, Orthogonality of Legendre's polynomial, Rodrigue's formula. **(08 Hrs.)**
Unit IV	Bessel's equation: Solution of Bessel's equation, Generating function for $J_n(x)$, Recurrence formulae for $J_n(x)$. **(07 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO1: To study Fourier Series for odd and even function.
CO2: To study Half range Fourier sine and cosine series.
CO3: To learn Legendre's polynomials, recurrence formulae and Rodrigue's formula.
CO4: To solve Bessel's equation and study Recurrence formulae.

Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Textbook of Mathematical Methods: V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari : A Text Book of Mathematical Methods:, Dnyanpath Publication, Amravati, Second edition 2024.
2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, N. K. Puranik, V. D. Jadhao : A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, First edition 2022.
3] Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley and Sons, Inc. New York, 1999.
4] A. R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd., London.
5] Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972.
6] B. Courant and D. Hilbert : Methods of Mathematical Physics, Vol. I & II, Wiley-interscience, 1953.
7] I. N. Sneddon : Fourier transform, McGraw Hill Book Co.
8] Goyal and Gupta : Integral Transforms, Pragati Prakashan, Meerut.
9] Goyal and Gupta : Laplace and Fourier Transforms, Pragati Prakashan, Meerut, Twentieth Edition 2007.
10] B. M. Roy, Analysis, Das Ganu Prakashan, Nagpur, 2004.
11] Raisinghaniya, M. D., Integral Transform, S. Chand & Co., N. D.

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: **126233** / Mathematics

The Vertical/ Type of Course: Major / Lab Course – 13

Course Name: Practical Based on Mathematical Analysis (126230) & Partial Differential Equations (126231)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- Students should be able to find the fixed points and the cross-ratio of given Möbius transformations. Student should also identify the function is analytic or not.
- To grownup problem-solving skills, analytical thinking, and increase the computational proficiency in students.

Course Outcomes:

After successful completion of this course students will able to:

CO1: To identify the analytic function.

CO2: To study various methods for the solutions of first and second order partial differential equations.

CO3: Learn condition of compatibility of partial differential equations.

CO4: Learn the maxima and minima of a function.

CO5: To obtain the solution of wave equation and heat equation.

Sr. No.	List of Practical's to be covered	No. of Examples
Practical Based on Mathematical Analysis (126230) & Partial Differential Equations (126231)		
Practical Based on Group A		
1	To verify Cauchy–Riemann equations for a given function.	03
2	To find the conjugate of a function and corresponding analytic function by using Milne–Thomson method.	03
3	To determine the region in w-plane under the given transformation in z-plane.	03
4	To find the fixed points and determine its normal form.	03
5	To find integrals of some functions by using integral as a limit of a sum.	03
6	To verify whether a given function defines a metric on a set	03
Practical Based on Group B		
1	To form the first order partial differential equations.	03
2	To find the general solution of first order partial differential equations by using Lagrange's method.	03
3	To find the complete solution of first order partial differential equations by using Charpit's general method.	03
4	To solve Homogeneous and non-homogenous second order partial differential equations with constant coefficients.	03
5	To find the extremals of the functional with the boundary conditions.	03
6	To solve wave equation and heat equation by Method of Separation of Variables.	03
Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**

Practical Book:

A Practical Book based on Mathematical Analysis & Partial Differential Equations: V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, M. C. Dhabe, S. S. Kedar, N. B. Nawale, A. O. Dhore, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, R. M. Dhaigude : A Text book of Mathematical Analysis, Dnyanpath Publication, Amravati, First Edition, 2026.

2] A Textbook of Partial Differential Equations: V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, S. R. Kumbhare, T. D. Nakade, S. H. Shaikh, Dnyanpath Publication, Amravati, First edition 2026.

3] V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari : A Text book of Mathematical Analysis, Dnyanpath Publication, Amravati, Second Edition, 2024.

4] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, V. J. Gaikwad, R. M. Dhaigude : A Text Book of Mathematical Analysis, Dnyanpath publication, Amravati, First edition 2022.

5] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, S. R. Kumbhare, T. D. Nakade, S. H.

Shaikh: A Text Book of Partial Differential Equation, Dnyanpath publication, Amravati, First Edition 2023.
6] Walter Rudin: Principles of Mathematical Analysis, International student's edition (Third edition)
7] T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.,
8] S. Lang : Undergraduate Analysis, Springer-Verlag New York, 1983.
9] D. Somasundaram & B. Choudhari : A First Course in Mathematical Analysis, New Delhi. 1997.
10] Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.
11] S. C. Malik and Arora : Mathematical Analysis, Wiley Estern Ltd., New Delhi.
12] Murray D.A.: Introductory course in Differential Equations, Orient Longman (India), 1967.
13] Erwin, Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 1999.
14] Piaggio HTS: Differential Equations, CBS Publishers &Distributors, Delhi, 1985.
15] Siminons G.F.: Differential Equations, Tata McGraw Hill, 1972.
16] A.R. Forsyth. A Treatise on Differential Equations. Macmillan and Co. Ltd. London.
17] Ian N., Sneddon, Elements of Partial Differential Equations. McGraw-Hill Book Company, 1988.
18] Jane Cronin. Differential equations, Marcel Dekker, 1994.
19] Frank Ayres. Theory and Problems of Differential Equations. McGraw Hill Book Company, 1972.
20] Richard Bronson, Theory and Problems of Differential Equations, McGraw Hill Inc, 1973.
21] A. S. Gupta: Calculus of Variations with Applications, Prentice-Hall of India, 1997.
22] I. M. Gelfand and S. V. Fomin: Calculus of Variations, Prentice-Hill Englewood Cliffs (New Jersey), 1963.

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: **126234** / Mathematics

The Vertical/ Type of Course: Major (Elective) / Theory -1

Course Name: Classical Mechanics (Optional)

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To learn how to calculate velocity and acceleration components along each axis and to apply coordinate axis methods to solve real-life motion problems. Also to understand motion in polar coordinates.
- To understand the concept of degree of freedom in mechanical systems and to classify systems based on their degrees of freedom. Also to classify different types of forces and their effects in plane.

Unit	Content
Unit I	Velocities and Acceleration along the co-ordinate axes, Radial and Transverse directions, Tangential and Normal directions, Projectile motion. **(08 Hrs.**)
Unit II	Degree of freedom, Constraints, Generalized Co-ordinates, D'Alembert Principles and Lagrange's equations of motions. **(07 Hrs.)**
Unit III	Central force motion, Areal velocity, Equivalent one body problem, Central orbit, Virial theorem, Kepler's laws of motion (statement only). **(08 Hrs.)**
Unit IV	Coplanar forces, forces acting at a point, triangle law of forces, Parallel forces, Equilibrium Forces, Lami's Theorem, Analytical condition of equilibrium of Coplanar forces. **(07 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:
CO1: learn radial and transverse component of velocities and acceleration.
CO2: learn to explain Degree of freedom, Generalized co-ordinates and constraints.
CO3: learn to expressing the central force motion and areal velocity.
CO4: explain the significance of coplanar forces, triangle law of forces, parallel forces and equilibrium forces.

Internal Assessment	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based

(20 Marks)	b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:
A Textbook of Classical Mechanics: V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, A. P. Wasnik, P. R. Langade, Y. U. Naner, A. M. Bagade, M. D. Netnaskar, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. P. Wasnik, P. R. Langade, Y. U. Naner, A. M. Bagade, N. B. Nawale, M. D. Netnaskar : A Text Book of Classical Mechanics, Dnyanpath Publication, Amravati, First edition 2024.
2] H. Goldstein: Classical Mechanics (2nd edition) Narosa publishing house, New Delhi, 1998.
3] D. A. Wells: Lagrangian Dynamics, McGraw Hill, 1967.
4] J. L. Synge, B.A. Griffith: Principles of Mechanics, McGraw Hill, 1959.
5] M. R. Spiegel: Theoretical Mechanics, McGraw Hill, 1983.
6] L.D. Landau, E. M. Lifschitz: Mechanics, Pergamon Press, 1976.
7] B. R. Gossick: Hamilton's Principle and Physical Systems, Academic Press, 1967.
8] S. L. Loney : An Elementary Treatise on the Dynamics of a particle and of rigid bodies, Cambridge University Press,1956.
9] P. K. Mittal: Mathematics for Degree Students, S. Chand & Co Ltd, New Delhi, 2011.

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: **126235** / Mathematics

The Vertical/ Type of Course: Major (Elective) / Lab Course – 14

Course Name: Practical Based on Classical Mechanics (126234)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- To learn how to calculate velocity and acceleration components along each axis and to apply coordinate axis methods to solve real-life motion problems. Also to understand motion in polar coordinates.
- To understand the concept of degree of freedom in mechanical systems and to classify systems based on their degrees of freedom. Also to classify different types of forces and their effects in plane.

Course Outcomes:

After successful completion of this course students will able to:
CO1: To learn how to find velocity and acceleration from the position vectors.
CO2: To learn about Lagrange's equation of Motion.
CO3: Learn to explain Degree of freedom, Generalized co-ordinates and constraints.
CO4: Derive equations of motion using D'Alembert's principle and Lagrange's equations, and compare them with Newtonian formulations.
CO5: explain the significance of coplanar forces, triangle law of forces, parallel forces and equilibrium forces.

Sr. No.	List of Practical's to be covered	No. of Examples
Practical Based on Classical Mechanics (126234)		
Practical Based on Group A		
1	To find the velocity and acceleration from the position vectors.	03
2	To determine the radial and transverse components of velocity and acceleration for planar motion.	03

3	To derive Lagrange's equations of motion for a system using generalized coordinates.	03
4	To determine the degree of freedom of a simple mechanical system with given constraints.	03
5	To apply D'Alembert's principle to obtain the equations of motion of a simple mechanical system.	03
6	To obtain the equation of motion of a particle using Lagrange's method and compare it with Newtonian results.	03
Practical Based on Group B		
1	To verify the conservation of areal velocity for motion under a central force.	03
2	To verify the Virial Theorem for a particle moving under a central force.	03
3	To derive the relation between force law and orbit for central force motion	03
4	To verify the triangle law of forces for coplanar concurrent forces.	03
5	To study coplanar forces acting at a point and determine the resultant force graphically.	03
6	To determine the unknown force required to keep a system of coplanar forces in equilibrium.	03
Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**

Practical Book:

A Practical Book based on Classical Mechanics: V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, G. D. Kanade, K. M. Kale, S. L. Munde, M. P. Shende, Dnyanpath Publication, Amravati, 2026.

Reference Books:

1] V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, A. P. Wasnik, P. R. Langade, Y. U. Naner, A. M. Bagade, M. D. Netnaskar : A Textbook of Classical Mechanics, Dnyanpath Publication, Amravati, First edition 2026.

2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. P. Wasnik, P. R. Langade, Y. U. Naner, A. M. Bagade, N. B. Nawale, M. D. Netnaskar : A Text Book of Classical Mechanics: Dnyanpath Publication, Amravati, First edition 2024.

3] H. Goldstein: Classical Mechanics (2nd edition) Narosa publishing house, New Delhi, 1998.

4] D. A. Wells: Lagrangian Dynamics, McGraw Hill, 1967.

5] J. L. Synge, B.A. Griffith: Principles of Mechanics, McGraw Hill, 1959.

6] M. R. Spiegel: Theoretical Mechanics, McGraw Hill, 1983.

7] L.D. Landau, E. M. Lifschitz: Mechanics, Pergamon Press, 1976.

8] B. R. Gossick: Hamilton's Principle and Physical Systems, Academic Press, 1967.

9] S. L. Loney : An Elementary Treatise on the Dynamics of a particle and of rigid bodies, Cambridge University Press,1956.

10] P. K. Mittal: Mathematics for Degree Students, S. Chand & Co Ltd, New Delhi, 2011.

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: **126236** / Mathematics

The Vertical/ Type of Course: Major (Elective) / Theory -2

Course Name: Number Theory (Optional)

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To understand the concepts of divisibility and apply basic divisibility rules. Also to find Greatest common divisor of two or more integers using different methods including Euclidean algorithm and use these tools in real-life applications.

- To apply Diophantine equations in real-life mathematical problems. To learn mathematical methods for determining the day of a given date. Also to apply how congruence's are used in real-life timekeeping systems.

Unit	**Content**
Unit I	Divisibility, Division Algorithm, The greatest common divisor, Greatest common divisor of more than two integers, Euclidean algorithm, Least common multiple. **(07 Hrs.)**
Unit II	Linear Diophantine equation, The mobius inversion formula, The greatest integer function, An application to the calendar. **(08 Hrs.)**
Unit III	Special divisibility test, linear congruences, Chinese remainder theorem. **(07 Hrs.)**
Unit IV	Primitive roots, primitive roots for prime, polynomial congruences, The congruence $x^2 \equiv a \pmod{p}$, general quadratic congruence, quadratic residues. **(08 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:
CO1: Familiar with Fundamental concepts of Number theory
CO2: To apply Euclid's algorithm and backwards substitution.
CO3: Add and subtract integers, modulo n, multiply integers and calculate powers.
CO4: Determine multiplicative inverses, modulo n and use to solve linear congruences.

Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Textbook of Number Theory: V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, N. S. Bayaskar, P. B. Gaikwad, I. D. Pawade, A. F. Gotarkar, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] D. M. Burton: Elementary Number Theory, McGraw Hill, New Delhi, Seventh Edition 2009.
2] C.Y. Hsiung: Elementary Theory of Numbers, Allied Publishers Ltd.1992.
3] I. Niven, H. S. Zuckerman and H. L. Montgomery: An introduction to the Theory of Numbers, Wiley Student Edition, Fifth edition 2004.
4] T. M. Karade, J. N. Salunke, K. D. Thengane, M. S. Bendre: Lectures on Elementary Number Theory, Sonu-Nilu Publication 2005.
5] K. H. Rosen: Elementary Number Theory and its Applications, Addison-Wesley, 1986.
6] K. Irland and M. Rosen: A Classical Introduction to Modern Number Theory, GTM Volume 84, Springer-Verlag 1972
7] G. A. Jones and I. M. Jones: Elementary Number Theory, Springer, 1998.
8] W. Slerpinski: Elementary theory of Number, North-Holland, 1988, Ireland.
9] K. Rosen and M. Rosen: A classical Introduction to Modern Number Theory, GTM Volume 94, Springer-Verlag, 1972.

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: **126237** / Mathematics

The Vertical/ Type of Course: Major (Elective) / Lab Course – 15

Course Name: Practical Based on Number Theory (126236)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- To understand the concepts of divisibility and apply basic divisibility rules. Also to find Greatest common divisor of two or more integers using different methods including Euclidean algorithm and use these tools in real-life applications.

- To apply Diophantine equations in real-life mathematical problems. To learn mathematical methods for determining the day of a given date. Also to apply how congruence are used in real-life timekeeping systems.

Course Outcomes:

After successful completion of this course students will able to:

CO1: Familiar with Fundamental concepts of Number theory.
CO2: To apply Euclid's algorithm and backwards substitution.
CO3: Add and subtract integers, modulo n, multiply integers and calculate powers.
CO4: Determine multiplicative inverses, modulo n and use to solve linear congruences.
CO5: To apply Chinese Remainder Theorem for solution of congruences and calendar calculations.

Sr. No.	List of Practical's to be covered	No. of Examples
Practical Based on Number Theory (126236)		
Practical Based on Group A		
1	To find the GCD of two numbers by using Euclidean algorithm	03
2	To find the LCM of numbers.	03
3	To find the solution of Linear Diphantine equation.	03
4	To solve examples on congruences.	03
5	To find the solutions of congruences.	03
6	To solve the system of three congruences by Chinese Remainder theorem.	03
Practical Based on Group B		
1	To solve the linear congruences using Euler's theorem.	03
2	To find the primitive root of odd prime numbers.	03
3	To find the solution of quadratic congruences.	03
4	To find quadratic residues of some numbers.	03
5	Examples on Applications of Modulo Arithmetic in Clocks	03
6	Examples on Applications of Modulo Arithmetic in Calendars	03
Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**

Practical Book:

1) A Practical Book based on Number Theory: V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, S. B. Tadam, R. R. Atram, P. R. Surushe, R. M. Kamble, Dnyanpath Publication, Amravati, 2026.

Reference Books:

1] V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, N. S. Bayaskar, P. B. Gaikwad, I. D. Pawade, A. F. Gotarkar: A Textbook of Number Theory, Dnyanpath Publication, Amravati, First edition 2026.
2] D. M. Burton: Elementary Number Theory, McGraw Hill, New Delhi, Seventh Edition 2009.
3] C.Y. Hsiung: Elementary Theory of Numbers, Allied Publishers Ltd.1992.
4] I. Niven, H. S. Zuckerman and H. L. Montgomery: An introduction to the Theory of Numbers, Wiley Student Edition, Fifth edition 2004.
5] T. M. Karade, J. N. Salunke, K. D. Thengane, M. S. Bendre: Lectures on Elementary Number Theory, Sonu-Nilu Publication 2005.
6] K. H. Rosen: Elementary Number Theory and its Applications, Addison-Wesley, 1986.
7] K. Irland and M. Rosen: A Classical Introduction to Modern Number Theory, GTM Volume 84, Springer-Verlag 1972
8] G. A. Jones and I. M. Jones: Elementary Number Theory, Springer, 1998.
9] W. Slerpinski: Elementary theory of Number, North-Holland, 1988, Ireland.
10] K. Rosen and M. Rosen: A classical Introduction to Modern Number Theory, GTM Volume 94, Springer-Verlag, 1972.

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: **126238** / Mathematics

The Vertical/ Type of Course: Minor / Theory -3

Course Name: Introduction to Transform Technique and Algebra

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To understand why transforms are used in mathematics, engineering, and science. Also to understand Laplace and Fourier transforms makes hard problems easier by converting them into algebraic equations.
- To introduce fundamental algebraic concepts, structures, and techniques, enabling them to solve equations, manipulate algebraic expressions, and apply algebraic methods to problem-solving. Also to build a strong foundation for advanced studies in abstract algebra.

Unit	**Content**
Unit I	Laplace Transform: Laplace transform of some elementary functions, Existence of Laplace transform, Properties of Laplace transform, Multiplication of t^n and division by t, Laplace transform of derivatives and integrals, Inverse Laplace transform. **(08 Hrs.)**
Unit II	Fourier Transform: Finite Fourier Sine Transform and Finite Fourier Cosine Transform; Inverse finite Fourier sine transform and cosine transform, Infinite Fourier transform, Infinite Fourier sine transform and cosine transform. **(07 Hrs.)**
Unit III	Group & Subgroup: Definition of a group with examples, Properties of group, Subgroups, Cosets, Lagrange's theorem, Normal subgroups, Different Characterization of normal subgroups, Quotient group **(08 Hrs.)**
Unit IV	Homomorphism, Isomorphism & Ring: Homomorphism, Homomorphic image, Kernel of Homomorphism, Isomorphism of a group, Definition of ring, examples and Properties of a ring, Subring, Characterization of ring. **(07 Hrs.)**

Course Outcomes:	
After successful completion of this course students will able to: **CO1**: To study Laplace Transform and its properties. **CO2:** To study Fourier Transform and its properties. **CO3:** Learn the concept of Group, Normal Subgroups, Cosets and its significance. **CO4:** Learn the concept of Homomorphism & Isomorphism and its kernel.	
Internal Assessment	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based

(20 Marks)	b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Text Book of Introduction to Transform Technique and Algebra: V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari: A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, First edition 2026.

2] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari : A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, Second edition 2024.

3] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, N. K. Puranik, V. D. Jadhao : A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, First edition 2022.

4] V. A. Sharma G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari: A Text Book of Elements of Algebra, Dnyanpath Publication, Amravati, First edition 2025.

5] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar , A. N. Rangari, N. S. Bayaskar, R. V. Kene, P. B. Deshmukh, M. C. Dhabe: A Text Book of Elements Algebra: Dnyanpath publication, Amravati, First edition 2023.

6] Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley and Sons, Inc. New York, 1999.

7] B. Courant and D. Hilbert : Methods of Mathematical Physics, Vol. I & II, Wiley-interscience, 1953.

8] I. N. Sneddon : Fourier transform, McGraw Hill Book Co.

9] Goel and Gupta : Integral Transforms, Pragati Prakashan, Meerut.

10] Raisinghaniya, M. D., Integral Transform, S. Chand & Co., N. D.

11] I. N. Herstein: Topic in Algebra, Wiley Eastern Ltd, New Delhi,1975.

12] N. Jocobson: Basic Algebra, Vol. I and II W. H. Freeman, Hindustan Publishing Co.,1980.

13] Shanti Narayan: A Text Book of Modern Abstract Algebra, S. Chand and Co. New Delhi.

14] P.B. Bhattacharya, S. K. Jain and S. R. Nagpal: Basic Abstract Algebra (IInd Edition) Cambridge University Indian Edition, 1997.

15] D. S. Malik, J. N. Mordeson and M. K. Sen: Fundamental Abstract Algebra, McGraw Hill International Edition, 1997.

16] Goyal and Gupta, Laplace and Fourier Transforms, Pragati Prakashan, Meerut, Twentieth Edition 2007.

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: 126239 / Mathematics

The Vertical/ Type of Course: Minor / Lab Course – 16

Course Name: Practical Based on Introduction to Transform Technique and Algebra (126238)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- To learn the Laplace Transforms of standard functions such as polynomials, exponentials, trigonometric, and hyperbolic functions and to apply properties of Laplace transforms such as linearity, shifting, and scaling.
- To prepare students for applications of Laplace as well Fourier transforms in solving differential equations, integral equations and engineering problems. Also to develop problem-solving skills by applying theses transforms to simplify complex functions.

Course Outcomes:

After successful completion of this course students will able to:

CO1: Students will be able to solve simple problems involving Laplace transforms accurately.

CO2: Students will be able to use Laplace transforms as a tool in solving differential equations and related applications.

CO3: Students will be able to define the Fourier Transform and explain its fundamental concepts.

CO4: Students will be able to apply Fourier Transforms in solving differential equations and problems in engineering and physics.

CO5: To learn basic concepts of algebra.

Sr. No.	List of Practical's to be covered		No. of Examples
Practical Based on Introduction to Transform Technique and Algebra (126238)			
Practical Based on Group A			
1	To find the Laplace transforms of exponential functions		03
2	To find the Laplace transforms of trigonometric functions		03
3	To find the Laplace transforms of trigonometric hyperbolic functions.		03
4	To find the Laplace transforms of some general functions.		03
5	To find the Laplace transforms of integrals.		03
6	To find the Inverse Laplace Transforms.		03
Practical Based on Group B			
1	To find the Finite Fourier sine and finite fourier cosine transforms of functions.		03
2	To find the inverse finite fourier sine and cosine transforms of functions.		03
3	To find infinite fourier sine transform of functions.		03
4	To find infinite fourier cosine transforms of functions.		03
5	To solve some examples on groups.		03
6	To solve some examples on rings.		03
Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**3.** Practical Record- **15 Marks** **4.** Viva voce – **10 Marks**	
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**	

Practical Book:

A Practical Book based on Introduction to Transform Technique and Algebra: V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, S. B. Thool, R. P. Rewaskar, P. R. Langade, R. V. Kene, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari : A Text Book of Introduction to Transform Technique and Algebra: Dnyanpath Publication, Amravati, First edition 2026.

2] V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari: A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, First edition 2026.

3] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari: A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, Second edition 2024.

4] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, N. K. Puranik, V. D. Jadhao : A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, First edition 2022.

5] V. A. Sharma G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari: A Text Book of Elements of Algebra, Dnyanpath Publication, Amravati, First edition 2025.

6] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari, N. S. Bayaskar, R. V.

Kene, P. B. Deshmukh, M. C. Dhabe: A Text Book of Elements Algebra, Dnyanpath publication, Amravati, First edition 2023.
7] I. N. Sneddon : Fourier transform, McGraw Hill Book Co.
8] Goel and Gupta : Integral Transforms, Pragati Prakashan, Meerut.
9] Raisinghaniya, M. D., Integral Transform, S. Chand & Co., N. D.
10] N. Jocobson: Basic Algebra, Vol. I and II W. H. Freeman, Hindustan Publishing Co.,1980.
11] Shanti Narayan: A Text Book of Modern Abstract Algebra, S. Chand and Co. New Delhi.
12] P.B. Bhattacharya, S. K. Jain and S. R. Nagpal: Basic Abstract Algebra (IInd Edition) Cambridge University Indian Edition, 1997.
13] D. S. Malik, J. N. Mordeson and M. K. Sen: Fundamental Abstract Algebra, McGraw Hill International Edition, 1997.

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: 126240 / Mathematics

The Vertical/ Type of Course: VSC (Vocational Skill Course) / Lab Course-17

Course Name: Mathematics in MS-Excel

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- The course is designed to develop students gain as well entrepreneurs to know how to use MS- Excel in business. This course involves the practical application of MS-Excel.

- To boost the skill development credibility and improve the ability of the students in working with MS-Excel to use in their day-to-day life.

Unit	**Content**
Unit I	**Basics of MS-EXCEL:** Create Worksheets and Workbooks, import data from a delimited text file, add a worksheet to an existing workbook, copy and move a worksheet, navigate to a named cell, range, or workbook element, insert and remove hyperlinks. **(07 Hrs.)**
Unit II	**Formulas and Functions in MS-EXCEL:** Perform operations with formulas and functions, insert references, perform calculations by using the SUM function, perform calculations by using MIN and MAX functions, perform calculations by using the COUNT function, perform calculations by using the AVERAGE function. **(07 Hrs.)**
Unit III	**Common Functions and Formula Errors:** Rules to enter a function, perform conditional operations by using functions, perform logical operations by using the IF function, perform logical operations by using the SUMIF function, perform logical operations by using the AVERAGEIF function, protect a worksheet, protect a worksheet and workbook structure, encrypt a workbook with a password. **(08 Hrs.)**
Unit IV	**Charts, Components of Charts and its Types:** Create a new chart, switch between rows and columns in source data, analyze data by using quick analysis format charts, resize charts, add and modify chart elements, apply chart layouts and styles, move charts to a chart sheet, insert and format objects, insert text boxes, shapes & image in an excel worksheet, modify object properties, add alternative text to objects for accessibility, printing a worksheet. **(08 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1**: Open the Excel spread sheet and can enter the data in worksheet. **CO2:** Perform various mathematical calculations and can learn the use of excel as calculator. **CO3:** Represent data into charts, diagrams, graphs, etc.	

CO4: Set up print area of worksheet. **CO5:** Apply Excel skills to solve real-world business problems. **CO6:** Course is to bring about inclusive growth and enable the Youth who have technical education to work in different aspects.

Practical Book:

A Practical Book on Mathematics in Ms-Excel: V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, P. B. Deshmukh, N. G. Ghungarwar, M. S. Palaspagar, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] Michael Alexander and John Walkenbach, Microsoft Excel Dashboards and Reports, 2nd Edition, Wiley. (2013).
2] Greg Harvey, Microsoft Excel 2019 All-in-one for Dummies, Wiley (2019).
3] John Walkenbach, Excel 2016 Bible (2018).
4] Schmuller, Joseph, Statistical Analysis with Excel, 4th Edition (2020).
5] https://support.microsoft.com/en-us/office/video-basic-math-in-excel-2013-e05703f5-7150-44c1-8a52-307738266821

Sr. No.	List of Practical's to be covered
	Practical Based on Group A
1	To create a new workbook, inserting values, calculating and saving the workbook
2	To demonstrate the process of working with the If Statement.
3	To work with inserting charts and graphs (Line, Bar, Pie, Scatter) in Excel Workbook
4	To work with SUM IF and COUNT IF Statements.
5	To demonstrate the process of Encrypting Excel Workbook.
6	Preparation of result sheets / mark sheets using MS Excel.
	Practical Based on Group B
1	To perform formulas (MAX, MIN, AVERAGE, SUM, COUNT).
2	To analysis percentage numeric format.
3	To operate number, commas and decimal numeric formats.
4	To apply Ms-Excel for managing product information.
5	Use of Excel for data analysis: Mean, median, standard deviation, variance.
6	To create sales report in MS-Excel.
Internal Practical Assessment (50 Marks)	**1.** Practical Perform – **30 Marks** (Perform any one from group A and B, each carry **15 marks**) **2.** Practical Record- **10 Marks** **3.** Viva voce– **10 Marks**

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: **126241** / Mathematics

The Vertical/ Type of Course: SEC (Skill Enhancement Course) / Lab Course – 18

Course Name: Practical on Mathematical Methods

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- To understand the concept of Fourier Series and its importance in representing periodic functions. Also to develop Fourier Series expansions and it apply to practical mathematical and engineering problems.
- To apply recurrence formulas for solving boundary value problems and building higher-degree polynomials. Also to understand how recurrence helps compute higher-order functions efficiently.

Unit	Content
Unit I	Fourier Series: Introduction, Periodic functions, Dirichlet's condition, Even & Odd functions, Determination of Fourier Coefficients, Fourier Series for even and odd function. Examples. **(08 Hrs.)**
Unit II	Half Range Fourier Series: Construction of Half range Sine Series, Construction of Half range Cosine Series. Parseval's identity (statement only). Examples. **(07 Hrs.)**
Unit III	Legendre's equation: Legendre's polynomials, generating function of $P_n(x)$, recurrence formulae for $P_n(x)$, Orthogonality of Legendre's polynomial, Rodrigue's formula. **(08 Hrs.)**
Unit IV	Bessel's equation: Solution of Bessel's equation, Generating function for $J_n(x)$, Recurrence formulae for $J_n(x)$. **(07 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO1: To develop Fourier series expansion of periodic function and apply Fourier series techniques to mathematical and engineering problems.

CO2: To understand and construct the Half Range Fourier Sine and cosine series and apply it in boundary value problems, heat flow, and signal analysis.

CO3: To learn about Sturm-Liouville Equation, how to find its solutions, eigen values and eigen functions.

CO4: To learn various recurrence formulae and solution of Bessel's equation and its solution.

Practical Book:

1) A Practical Book on Mathematical Methods: V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, S. M. Pawar, S. A. Salve, S. B. Khobragade, S. V. Gore, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari : A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, First edition 2026.

2] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari : A Text Book of Mathematical Methods: Dnyanpath Publication, Amravati, Second edition 2024.

3] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, N. K. Puranik, V. D. Jadhao : A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, First edition 2022.

4] Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley and Sons, Inc. New York, 1999.

5] A. R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd., London.

6] Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972.

7] B. Courant and D. Hilbert : Methods of Mathematical Physics, Vol. I & II, Wiley-interscience, 1953.

8] I. N. Sneddon : Fourier transform, McGraw Hill Book Co.

9] Goel and Gupta : Integral Transforms, Pragati Prakashan, Meerut.

10] Raisinghaniya, M. D., Integral Transform, S. Chand & Co., N. D.

Sr. No.	List of Practical's to be covered	No. of Examples
	Practical Based on Group A	
1	To find the Fourier Series of various functions.	03
2	To find the Fourier series of an odd function and draw the graph with the given interval.	03
3	To find the Fourier series of an even function.	03
4	To find the Fourier series for the periodic function.	03
5	To find the half range Fourier sine series of the function	03
6	To find half range Fourier cosine series of the function.	03
	Practical Based on Group B	

1	To find the polynomials $P_n(x)$, *for* $n = 0, 1, 2, 3, 4, 5$	03
2	To find all the eigen values and eigen functions of the Sturm-Liouville Equation.	03
3	To find all the eigen values and eigen functions of the System of differential equations.	03
4	To solve the Bessel's Equation by Series Method	03
5	To solve problems involving heat conduction and wave propagation using Bessel's function.	03
6	To calculate the values of Bessel functions for different orders and arguments.	03
Internal Practical Assessment (50 Marks)	**1.** Practical Perform – **30 Marks** (Perform any one from group A and B, each carry **15 marks**) **2.** Practical Record- **10 Marks** **3.** Viva voce– **10 Marks**	

Program	B. Sc. III (Mathematics) Sem-V
Type of Course	Field Project / Community Engagement and Services **(FP/CES)**
Course Code	**126242**
Number of Credits	2
Total Hours per Week	4 Hrs**.**
Contact Hours	90 Hrs. / 60 Hrs.
Project Page Length	20 –30 pages
Max. Marks	**50**

Course Objectives	1. To understand the application of mathematical concepts in solving real-life and practical problems. 2. To acquire practical experience in collecting, organizing, and analyzing data using mathematical techniques. 3. To develop strong problem-solving abilities through the use of mathematical models and statistical methods. 4. To enhance logical reasoning, analytical thinking, and the ability to interpret results effectively. 5. To build research aptitude, collaborative skills, and proficiency in preparing systematic project reports through field-based work.
Course Outcomes	**After successful completion of this course/project work, students will be able to:** 1. Employ suitable mathematical models to examine and interpret real-world problems. 2. Systematically gather, arrange, and analyze data using mathematical and statistical methods. 3. Utilize computational tools such as Excel, Python, MATLAB, and similar software for numerical analysis and graphical representation. 4. Communicate project results clearly and effectively through well-structured reports and oral presentations. 5. Perform mathematical investigations both independently and as part of a collaborative team in field-based settings.

SOP for Field Project (FP) and Community engagement and services (CES):

As per the provisions of NEP 2020, students of B.Sc. III, Semester V are required to undertake a Field Project (FP) or Community Engagement and Services (CES) course of two (02) credits, carrying a maximum of 50 marks. For a comprehensive understanding of the key principles, various forms of CES, operational guidelines and the implementation strategy, students are advised to refer the relevant prescribed guidelines https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf .

The guidelines regarding the field project are as follows:

1. Prepare the Field Project (FP) / Community Engagement and Services (CES) report strictly according to the prescribed structure.
2. Select the project title and methodology in alignment with the suggested project areas and community services.
3. Finalize the FP / CES project title in consultation with the Project Guide and the Head of the Department.
4. Begin the project work well in advance and plan the schedule carefully, especially for data collection and field activities.
5. Ensure that mathematical concepts and explanations are clear, simple, and directly related to the chosen project title.
6. Use appropriate graphs, charts, and figures wherever possible to enhance clarity and understanding of the concepts.
7. Maintain academic integrity by avoiding plagiarism; write in your own words and provide proper citations wherever required.
8. The project report should consist of a minimum of 20–30 pages, excluding appendices if any.
9. Submit the final project report to the department with the signatures of the Project Guide and the Head of the Department.
10. Preparation and presentation of a poster and/or PowerPoint presentation on the project is mandatory and shall be evaluated by the Head of the Department.

Structure of a Field Project (FP) and Community Engagement and Service (CES)

The proposal of the Field Project (FP) and Community Engagement and Service (CES) project should be prepared and presented according to the following structure.

Sr. No.	Section	No. of Pages	Contents / Description
1	Title Page	01	Project Title, Student Name, Roll No., Class, Semester, Institution, Guide's Name, Date of submission
2	Certificate	01	Statement signed by student, Supervisor and Head of Department certifying authenticity of work
3	Acknowledgement	01	Thanks to guide/HOD, institution, friends, and data sources
4	Abstract	01	Brief summary: objectives, methods, key results, conclusion
5	Introduction	03	Background of topic, motivation, importance, objectives of study
6	Literature Review	03	Short overview of related studies, books, or research articles.
7	Theory	08	Mathematical Background: Explanation of formulas, models, or theorems used in the project.
8	Methodology	05	Data collection Method used as like survey, observation, census, secondary data etc. Also, tools and software used as Excel, Python, etc.
9	Collected Data Analysis	03	Collected data in tables, graphs, charts; applying mathematical/statistical methods for analysis.
10	Results and Interpretation	02	Final calculated results, model fitting, graphs with explanation of real-world meaning
11	Conclusions	01	Summary of findings, importance of results, limitations, scope for further work
12	References	02	List of books, journals, websites referred (APA/IEEE format)
	Total Pages	**30**	

Some Areas for Field Projects in Mathematics and Methodologies:

Integrating Mathematics with Field Projects helps students to understand the real-world value of the subject. Some suggested areas for field projects in Mathematics and methodology in order to prepare the project proposal are as follows:

Sr. No.	Field Projects on Mathematics in	Methodology
1	Technology and Computing Applications	Choose anyone methodology from among the following: 1. Survey Method
2	Artificial Intelligence and Data Science	
3	Economics, Business, and Financial Analysis	

4	Biological Sciences and Medical Applications	2. Observational Method 3. Experimental Method 4. Statistical Method 5. Comparative Method 6. Projective Method 7. Modeling Method
5	Climate Science and Weather Forecasting	
6	Music, Performing Arts, and Visual Arts Analysis	
7	Politics, Governance, and Electoral/Voting Processes	
8	Social Media Analytics and Sports Science	
9	Applied Sciences and Industrial Applications	
10	Survey-Based Statistical and Data Analysis	

Benefits of FP in Mathematics:

1. Enables students to recognize and apply mathematical concepts to real-life and practical contexts.
2. Strengthens analytical reasoning and logical thinking through experiential learning activities.
3. Creates awareness of the role of mathematics in addressing social, economic, and local community challenges.
4. Promotes the integration of mathematics with science, economics, technology, and everyday applications.
5. Motivates students to develop mathematical models, surveys, and innovative solutions.
6. Encourages inquiry, evaluation, and reasoned interpretation of mathematical results.
7. Enhances teamwork, communication, and peer-to-peer learning during project execution.
8. Builds competencies in research methodology, data collection, analysis, and effective presentation.
9. Helps students relate mathematical knowledge to professional domains such as data science, engineering, finance, and technology.
10. Fosters independent learning and self-confidence in applying mathematics beyond classroom settings

Various Community Engagement and Services (CES) in Mathematics:

Linking Mathematics with Community Engagement that helps students to see the social relevance of the subject. Some suggested community engagement services in Mathematics are tabulated as follows. Students have to choose any one of the following community engagement services.

	Services/Activities	Description
1	Academic Tutoring and Peer Support	Students provide free math tutoring for weaker school students in nearby villages and towns.
2	Mathematical Literacy and Awareness Camps	Students can organize workshops in nearby schools, communities to teach basic numeracy, mental arithmetic and problem-solving.
3	Local Data Analysis Projects	Students collect data on local topics as like water usage, traffic, school attendance, etc. and analyse using statistics.
4	Mathematics for Small Businesses	Students help to small shopkeepers, vendors in inventory control, profit-loss calculation, and pricing using simple maths methods.
5	Mathematics and Technology Drives	Students demonstrate use of spreadsheets in Excel, basic coding, or mobile apps for calculations to community members.
6	Environmental and Social Survey	Students apply statistical methods to study pollution levels, waste management, energy usage, or health surveys in localities.
7	Math in Daily Life Programs	Students prepare posters, street plays, or videos showing applications of mathematics in cooking, shopping, travel, and construction.

Benefits of CES in Mathematics:

1. Cultivates empathy, social responsibility, and leadership qualities among students.
2. Encourages the development of innovative models and practical solutions to address community challenges.

3. Facilitates meaningful interaction with schools, NGOs, industries, and local governance bodies.
4. Enables students to apply mathematical concepts to real-life problems faced by the community.
5. Strengthens problem-solving abilities, analytical thinking, teamwork, and effective communication.
6. Promotes awareness of social issues and highlights the role of mathematics in developing viable solutions.
7. Enhances presentation skills, decision-making abilities, and leadership potential.
8. Demonstrates the practical contribution of mathematics in addressing societal and local concerns.
9. Provides hands-on learning experiences beyond conventional classroom instruction.
10. Prepares students for employment, higher education, and research dissemination through practical, field-based projects.

SOP for Assessment Process of FP/CES Project (Marks Distribution)		
Sr. No.	**Component**	**Marks**
1	Submission of FP or CES Project Proposal as per the structure	30
2	Report Writing and PPT Presentation	10
3	Viva-Voce / Oral Examination	10
	Total	**50**

SEMESTER VI

Syllabus Prescribed from the year 2026-27, UG Program (NEP) Semester VI

Program: B. Sc.- III (Mathematics) Semester - VI

Course Code / Subject: **126243** / Mathematics

The Vertical/ Type of Course: Major / Theory -11

Course Name: Linear Algebra

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To understand the fundamental concepts of vector spaces and their properties. Also to study linear dependence and independence, span, basis, and dimension of vector spaces.

- To understand and apply the Rank-Nullity Theorem in solving linear algebra problems. Also to introduce inner product spaces and study their geometric properties. In overall to develop analytical and problem-solving skills in abstract linear algebra.

Unit	**Content**
Unit I	Vector space: Definition and example of vector spaces, subspaces, sum and direct sum of subspaces, linear span, linear dependence, independence and their basic properties. **(08 Hrs.)**
Unit II	Basis: basis, finite dimensional vector spaces, existence theorem for bases, invariance of the number of elements of a basis set, dimension. **(07 Hrs.)**
Unit III	Linear transformations: Linear transformation and their representation as matrices, algebra of linear transformations, rank-nullity theorem, change of basis. **(08 Hrs.)**
Unit IV	Inner Product Spaces: Inner product spaces, Cauchy-Schwarz inequality, orthogonal vectors, orthogonal complements, orthonormal sets and bases, Bessel's inequality for finite dimensional spaces, Gram-Schmidt orthogonalization process. **(07 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** To learn the concept of Vector space, Subspace and Dimension. **CO2:** To understand the concept of linear dependent and independent vectors. **CO3:** To study Linear transformation and Rank nullity theorem. **CO4:** To learn Cauchy- Schwarz inequality, Bessel's inequality and Gram Schmidt orthogonalization Process.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Text Book of Linear Algebra: V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, S. J. Chavhan, M. G. Bhujade, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

l] V. A. Sharma, V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari, N. S. Bayaskar, K. S. Wankhade, S. J. Chavhan, R. P. Rewaskar: A Text Book of Linear Algebra, Dnyanpath Publication, Amravati, Second edition 2024.

2] I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
3] N. Jocobson: Basic Algebra, Vol. I and II W. H. Freeman, 1980 (Hindustan Publishing Co.).
4] Shanti Narayan : A Text Book of Modern Abstract Algebra, S. Chand and Co., New Delhi.
5] K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
6] P. B. Bhattacharya, S. K. Jain and S. R. Nagpal : Basic Abstract Algebra (IInd Edition) Cambridge University Press Indian Edition, 1997.
7] K. Hoffman and R. Kunze, : Linear Algebra, IInd Edition Prentice Hall, Englewood Cliffs, New Jersey, 1971.
8] S. K. Jain, A Gunawardhana and P. B. Bhattacharya : Basic Linear algebra with MATLAB, Key College Publishing (Springer-Verlag), 2001.
9] S. Kumaresan : Linear Algebra, A Geometric Approach, P Prentice Hall of India Pvt. Ltd. New Delhi, 2000
10] D. S. Malik, J. N. Mordeson and M. K. Sen : Fundamentals of Abstract Algebra, McGraw Hill International Edition 1997.
11] Joseph A. Gallian : Contemporary Abstract Algebra, Narosa publishing house.
12] P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul : First Course in Linear Algebra.
13] V. Krishnamurty, V. P. Mainru, J. L. Arrora : An Introduction to Linear Algebra.

Program: B. Sc.- III (Mathematics) Semester - VI

Course Code / Subject: **126244** / Mathematics

The Vertical/ Type of Course: Major / Theory - 12

Course Name: Advanced Analytical Algebra

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To strengthen analytical skills through problem-solving involving improper integrals, adjoint transformations and eigen analysis in mathematics, physics, and engineering applications.

- To introduce the algebraic structures of modules over a ring and its homomorphism and isomorphism. Also to develop abstract reasoning and problem-solving skills in linear algebra and module theory.

Unit	**Content**
Unit I	Improper integrals: Improper integrals and their convergence, Comparison and limit tests. **(07 Hrs.)**
Unit II	Dual Spaces: Dual space, bidual space and natural isomorphism, adjoint of a linear transformation, Eigen values and eigen vectors of a linear transformation. (**08 Hrs.)**
Unit III	Modules: Introduction, Ideals, Left R-Module, Right R-Module, Properties of Module, Unital R-module, submodules, Direct sum of submodules. **(07 Hrs.)**
UNIT IV	Homomorphism of Modules: Quotient modules, Homomorphism and kernel of Modules, Isomorphism theorems of Modules, Cyclic modules. (**08 Hrs.)**
Course Outcomes: After successful completion of this course students will able to: **CO1:** To learn various tests of convergence of improper integral. **CO2:** To learn dual space, bidual space, eigen value and eigen vectors of linear transformation. **CO3:** To learn general properties of modules. **CO4:** To study quotient modules, homomorphism and isomorphism theorem.	
Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:
A Text Book of Advanced Analytical Algebra: V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, K. S. Wankhade, R. P. Rewaskar, V. P. Kadam, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari: A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, Second edition 2024.
2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, V. J. Gaikwad, R. M. Dhaigude : A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, First edition 2022.
3] V. A. Sharma, V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari, N. S. Bayaskar, K. S. Wankhade, S. J. Chavhan, R. P. Rewaskar: A Text Book of Linear Algebra, Dnyanpath Publication, Amravati, Second edition 2024.
4] S. C. Malik and Arora : Mathematical Analysis, Wiley Estern Ltd., New Delhi.
5] Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.
6] Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley and Sons, Inc. New York, 1999.
7] B. Courant and D. Hilbert : Methods of Mathematical Physics, Vol. I & II, Wiley-interscience, 1953.
8] I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
9] N. Jocobson: Basic Algebra, Vol. I and II W. H. Freeman, 1980 (Hindustan Publishing Co.).
10] Shanti Narayan : A Text Book of Modern Abstract Algebra, S. Chand and Co., New Delhi.
11] K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
12] P. B. Bhattacharya, S. K. Jain and S. R. Nagpal : Basic Abstract Algebra (IInd Edition) Cambridge University Press Indian Edition, 1997.
13] K. Hoffman and R. Kunze, : Linear Algebra, IInd Edition Prentice Hall, Englewood Cliffs, New Jersey, 1971.
14] S. K. Jain, A Gunawardhana and P. B. Bhattacharya : Basic Linear algebra with MATLAB, Key College Publishing (Springer-Verlag), 2001.
15] S. Kumaresan : Linear Algebra, A Geometric Approach, P Prentice Hall of India Pvt. Ltd. New Delhi, 2000
16] D. S. Malik, J. N. Mordeson and M. K. Sen : Fundamentals of Abstract Algebra, McGraw Hill International Edition 1997.
17] Joseph A. Gallian : Contemporary Abstract Algebra, Narosa publishing house.
18] P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul : First Course in Linear Algebra.
19] V. Krishnamurty, V. P. Mainru, J. L. Arrora : An Introduction to Linear Algebra.

Program: B. Sc.- III (Mathematics) Semester - VI

Course Code / Subject: **126245** / Mathematics

The Vertical/ Type of Course: Major / Theory - 13

Course Name: Integral Transform Methods

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To understand the concept of Laplace Transform and its various properties. Use transform methods for solving initial value problems in science and engineering.
- To understand why transforms are used in mathematics, engineering, and science. Also to understand Laplace and Fourier transforms makes hard problems easier by converting them into algebraic equations.

Unit	Content
Unit I	Laplace transform: Laplace transform of some elementary functions, Linearity of Laplace transform. Existence theorem for Laplace transform, Shifting Theorem, Change of scale property, Laplace transform of derivatives. Multiplication by power of t. and division by t. **(08 Hrs.)**

Unit II	Inverse Laplace Transform: Shifting Theorem, Linearity and Change of scale property, Inverse Laplace transform of derivative, division by s. Convolution theorem. **(07 Hrs.)**
Unit III	Applications of Laplace Transform: Solution of integral equations and system of ordinary and partial differential equations using the Laplace transform. Solutions of simultaneous ordinary differential Equations using Laplace transform. **(07 Hrs.)**
Unit IV	Fourier Transform: Finite Fourier sine and cosine transform, Inverse finite Fourier sine transform and cosine transform, Infinite Fourier transform, Infinite Fourier sine transform and cosine transform, Properties of Fourier transform. **(08 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO1: To apply Laplace Transform techniques to initial value problems and system analysis.

CO2: To apply partial fractions, shifting properties, and standard formulas to obtain original functions.

CO3: To apply Laplace transforms in solving ordinary and partial differential equations.

CO4: To study Fourier transform and its properties.

Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Textbook of Integral Transform Methods: V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari : A Text Book of Mathematical Methods:, Dnyanpath Publication, Amravati, Second edition 2024.

2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, N. K. Puranik, V. D. Jadhao : A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, First edition 2022.

3] Goyal and Gupta, Laplace and Fourier Transforms, Pragati Prakashan, Meerut, 2007.

4] B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2012.

5] Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley and Sons, Inc. New York, 1999.

6] A. R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd., London.

7] Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972.

8] B. Courant and D. Hilbert : Methods of Mathematical Physics, Vol. I & II, Wiley-interscience, 1953.

9] I. N. Sneddon : Fourier transform, McGraw Hill Book Co.

10] Goel and Gupta : Integral Transforms, Pragati Prakashan, Meerut.

11] Raisinghaniya, M. D., Integral Transform, S. Chand & Co., N. D.

Program: B. Sc.- III (Mathematics) Semester - VI

Course Code / Subject: **126246** / Mathematics

The Vertical/ Type of Course: Major / Lab Course – 19

Course Name: Practical Based on Linear Algebra, Advanced Analytical Algebra and Integral Transform Methods (126243, 126244 & 126245)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- To understand the basic concepts and properties of vector spaces through problem solving. Also to develop ability to verify Rank-Nullity Theorem.

- To learn the properties and applications of orthogonal and orthonormal sets of vectors. Also to strengthen problem-solving, analytical, computational skills and proof-writing skills in linear algebra.
- To prepare students for applications of Laplace as well Fourier transforms in solving differential equations, integral equations and engineering problems. Also to develop problem-solving skills by applying theses transforms to simplify complex functions.

Course Outcomes:

After successful completion of this course students will able to:

CO1: Students will be to present clear mathematical proofs and solutions related to vector spaces and bases.

CO2: Students will be able to verify the Rank-Nullity theorem for a given linear transformation.

CO3: To learn how to find kernel and range of linear transformation.

CO4: Students will be able to construct an orthonormal basis using the Gram-Schmidt orthogonalization process.

CO5: To learn various tests of convergence of improper integral.

CO6: Students will be able to use Laplace transforms as a tool in solving differential equations and related applications.

CO7: Students will be able to define the Fourier Transform and explain its fundamental concepts.

Sr. No.	List of Practical's to be covered		No. of Examples
Practical Based on Linear Algebra, Advanced Analytical Algebra and Integral Transform Methods (126243, 126244 & 126245)			
	Practical Based on Group A		
1	To solve examples on vectors.		03
2	To verify the set of vectors are linearly dependent or linearly independent.		03
3	To find null space, range, rank, nullity and verify rank nullity theorem.		03
4	To find the matrix of linear transformation relative to the basis.		03
5	To find the linear transformation from the given matrix with respect to the bases.		03
6	To find orthogonal set and orthonormal basis set by using Gram-Schmidt orthogonalization process.		03
	Practical Based on Group B		
1	To test the integrals for convergence by comparison and limit tests.		03
2	To find the eigen values and eigen vectors of a given linear transformation.		03
3	To find the Laplace transforms of some functions.		03
4	To find the inverse Laplace transforms.		03
5	To solve some ordinary and partial differential equations by using Laplace transforms		03
6	To find finite & infinite fourier sine and cosine transforms of functions.		03
Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**	
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**	

Practical Book:

A Practical Book based on Linear Algebra, Advanced Analytical Algebra & Integral Transform Methods : V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, S. J.

Chavhan, C. S. Khodre, S.P. Gaikwad, V. B. Watkar, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, S. J. Chavhan, M. G. Bhujade: A Text Book of Linear Algebra, Dnyanpath Publication, Amravati, First edition 2026.
2] V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, K. S. Wankhade, R. P. Rewaskar, V. P. Kadam: A Text Book of Advanced Analytical Algebra, Dnyanpath Publication, Amravati, First edition 2026.
3] V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari : A Textbook of Integral Transform Methods Dnyanpath Publication, Amravati, First edition 2026.
4] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, A. N. Rangari : A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, Second edition 2024.
5] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, N. K. Puranik, V. D. Jadhao : A Text Book of Mathematical Methods, Dnyanpath Publication, Amravati, First edition 2022.
6] V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari : A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, Second edition 2024.
7] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, V. J. Gaikwad, R. M. Dhaigude : A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, First edition 2022.
8] V. A. Sharma, V. R. Patil, G. U. Khapekar, S. R. Bhoyar, A. N. Rangari, N. S. Bayaskar, K. S. Wankhade, S. J. Chavhan, R. P. Rewaskar: A Text Book of Linear Algebra, Dnyanpath Publication, Amravati, Second edition 2024.
9] S. C. Malik and Arora : Mathematical Analysis, Wiley Estern Ltd., New Delhi.
10] Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.
11] Goyal and Gupta, Laplace and Fourier Transforms, Pragati Prakashan, Meerut, 2007.
12] B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2012.
13] Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley and Sons, Inc. New York, 1999.
14] A. R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd., London.
15] Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972.
16] B. Courant and D. Hilbert : Methods of Mathematical Physics, Vol. I & II, Wiley-interscience, 1953.
17] I. N. Sneddon : Fourier transform, McGraw Hill Book Co.
18] Goel and Gupta : Integral Transforms, Pragati Prakashan, Meerut.
19] Raisinghaniya, M. D., Integral Transform, S. Chand & Co., N. D.
20] I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
21] N. Jocobson: Basic Algebra, Vol. I and II W. H. Freeman, 1980 (Hindustan Publishing Co.).
22] Shanti Narayan : A Text Book of Modern Abstract Algebra, S. Chand and Co., New Delhi.
23] K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
24] P. B. Bhattacharya, S. K. Jain and S. R. Nagpal : Basic Abstract Algebra (IInd Edition) Cambridge University Press Indian Edition, 1997.
25] K. Hoffman and R. Kunze, : Linear Algebra, IInd Edition Prentice Hall, Englewood Cliffs, New Jersey, 1971.
26] S. K. Jain, A Gunawardhana and P. B. Bhattacharya : Basic Linear algebra with MATLAB, Key College Publishing (Springer-Verlag), 2001.
27] S. Kumaresan : Linear Algebra, A Geometric Approach, P Prentice Hall of India Pvt. Ltd. New Delhi, 2000
28] D. S. Malik, J. N. Mordeson and M. K. Sen : Fundamentals of Abstract Algebra, McGraw Hill International Edition 1997.
29] Joseph A. Gallian : Contemporary Abstract Algebra, Narosa publishing house.
30] P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul : First Course in Linear Algebra.
31] V. Krishnamurty, V. P. Mainru, J. L. Arrora : An Introduction to Linear Algebra.

Program: B. Sc.- III (Mathematics) Semester - VI

Course Code / Subject: **126247** / Mathematics

The Vertical/ Type of Course: Major (Elective) / Theory -3

Course Name: Graph Theory (Optional)

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- Understand fundamental concepts of graph theory, including graphs, subgraphs, degree, paths, cycles, connectivity, and isomorphism. Also to analyze different types of graphs, such as directed and undirected graphs, weighted graphs, bipartite graphs, trees, planar graphs, and complete graphs.

- Use matrices and representations of graphs, such as adjacency matrices and incidence matrices, to analyze graph properties and to integrate graph theory concepts with applications in computer science, operations research, and discrete mathematics.

Unit	**Content**
Unit I	Graph. Application of graphs, finite and infinite graphs, incidence and degree, isolated vertex, pendent vertex and null graph, isomorphism, subgraphs, walks, path and circuits, connected graphs and components, Euler graph, operation on graphs, Hamiltonian paths and circuits. **(08 Hrs.**)
Unit II	Trees, some properties of trees, pendent vertices in a tree, distance and centres in a tree, Rooted and binary trees, spanning trees. **(07 Hrs.)**
Unit III	Fundamental circuits, Cutsets, Some properties of cutsets, all cutset in a graph, fundamental circuits and cutsets, connectivity and separability, planer graphs, Kurutowski's two graphs, different representation of planer graph. **(07 Hrs.)**
Unit IV	Vector space associated with a graph, circuit and cutset subspaces, Orthogonal vectors and spaces, Intersection and joint of W_Γ and W_S, Incidence matrix, Sub matrix of A(G), Circuit matrix, Fundamental circuit matrix B, Rank of B, cutset matrix, path matrix, Adjacency matrix. **(08 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO1: To learn graph and its types.
CO2: To learn about trees and its properties.
CO3: To study various circuits and representation of planer graph.
CO4: To study vector space associated with graph, Orthogonal vectors.
CO5: To learn various matrix and its relationship.

Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Textbook of Graph Theory: V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, S.M. Shingane, P. B. Deshmukh, S.R. Kumbhare, A.Y. Shaikh, A. P. Wasnik, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, S.M. Shingane, P. B. Deshmukh, S.R. Kumbhare, A.Y. Shaikh, A. P. Wasnik : A Text Book of Graph Theory, Dnyanpath Publication, Amravati, Second edition 2024.
2] Narsingh Deo: Graph Theory with Application to Engineering and Computer Science, Prentice Hall of India, New Delhi.
3] Richard Johnson- Baugh : Discrete Mathematics, Macmillan Publishing Company 886, Third Avenue New York 10022.
4] Olympia Nicodemi : Discrete Mathematics, C. B. S Publ. and Distributors 485, Jain Bhavan Bholanath Nagar Shahadara, New Delhi 32 India.
5] Frank Harare : Graph Theory ,Narosa Publishing House, 307, Shiv Centre D.B.C. Sector Ku

Bazar New Bombay 400704.
6] S. A. Choudum: A first Course in Graph Theory, McMillan India Ltd. Mercatile House Magazine Street Bombay 10.
7] E. L. LIU: Elements of Discrete Mathematics, McGraw Hill Book Company, New York.
8] Seymour Lipschiutz and Marc Lipson: Discrete Mathematics, TMH New Delhi (Schaum Outline series) IInd Edition.

Program: B. Sc.- III (Mathematics) Semester - VI

Course Code / Subject: **126248** / Mathematics

The Vertical/ Type of Course: Major (Elective) / Lab Course – 20

Course Name: Practical Based on Graph Theory (126247)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- Draw all simple graphs with one, two, three, and four vertices and distinguish between different graph structures. Also to construct trees for given sets of vertices and edges and verify their properties.
- Learn to calculate the eccentricity centre, radius, and diameter of a tree of each vertex in a given graph or tree. Find all possible spanning trees of a given connected graph. Also to determine the intersection of the circuit space and cutset space, i.e., $W_\Gamma \cap W_S$, of a graph and analyse its properties.

Course Outcomes:

After successful completion of this course students will able to:

CO1: To draw all simple graphs with one, two, three, and four vertices and analyze their structures.

CO2: To determine the incidence of edges and compute the degree of each vertex of a given graph.

CO3: To calculate distances and eccentricity of vertices and determine the center, radius, and diameter of a tree.

CO4: To Apply vector space concepts to graphs by finding $W_\Gamma \cap W_S$ and determining the rank of the fundamental circuit matrix.

CO5: To construct and analyze graph matrices such as the incidence matrix $A(G)$.

Sr. No.	List of Practical's to be covered		No. of Examples
Practical Based on Graph Theory (126247)			
Practical Based on Group A			
1	To draw all simple graphs of one, two, three, and four vertices.		03
2	To find the incidence of edges and calculate the degree of each vertex for a given graph.		03
3	To construct trees for given sets of vertices and edges.		03
4	To identify pendant (leaf) vertices in a given tree and find the degree of each vertex in a tree.		03
5	To find the distance between all pairs of vertices in a given tree and to construct the distance matrix.		03
6	To calculate eccentricity of each vertex.		03
	Practical Based on Group B		
1	To find the center, radius and diameter of a given tree using distance and eccentricity.		03
2	To find all possible spanning trees of a given connected graph.		03
3	To find a spanning tree of a connected graph.		03
4	To find find $W_\Gamma \cap W_S$.		03
5	To find rank of the fundamental circuit matrix		03
6	To construct the incidence matrix $A(G)$of a given graph.		03
Practical Assessment	Internal Practical Assessment	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**	

(50 Marks)	(25 Marks)	
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**

Practical Book:

A Practical Book based on Graph Theory: V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, S. M. Singane, P. B. Deshmukh, S. R. Kumbhare, A. Y. Shaikh, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, S.M. Shingane, P. B. Deshmukh, S.R. Kumbhare, A.Y. Shaikh, A. P. Wasnik : A Textbook of Graph Theory, Dnyanpath Publication, Amravati, First edition 2026.
2] V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, S.M. Shingane, P. B. Deshmukh, S.R.Kumbhare, A.Y. Shaikh, A. P. Wasnik : A Text Book of Graph Theory, Dnyanpath Publication, Amravati, Second edition 2024.
3] Narsingh Deo: Graph Theory with Application to Engineering and Computer Science, Prentice Hall of India, New Delhi.
4] Richard Johnson- Baugh : Discrete Mathematics, Macmillan Publishing Company 886,Third Avenue New York 10022.
5] Olympia Nicodemi : Discrete Mathematics, C. B. S Publ. and Distributors 485, Jain Bhavan Bholanath Nagar Shahadara, New Delhi32 India.
6] Frank Harare : Graph Theory ,Narosa Publishing House, 307, Shiv Centre D.B.C. Sector Ku Bazar New Bombay 400704.
7] S. A. Choudum: A first Course in Graph Theory, McMillan India Ltd. Mercatile House Magazine Street Bombay 10.
8] E. L. LIU: Elements of Discrete Mathematics, McGraw Hill Book Company, New York.
9] Seymour Lipschiutz and Marc Lipson: Discrete Mathematics, TMH New Delhi (Schaum Outline series) IInd Edition.

Program: B. Sc.- III (Mathematics) Semester - VI

Course Code / Subject: **126249** / Mathematics

The Vertical/ Type of Course: Major (Elective) / Theory -4

Course Name: Special Theory of Relativity (Optional)

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- To understand inertial frames of reference and analyses motion using Galilean relativity, highlighting its limitations in the context of the constancy of the speed of light. Explain the relative nature of space and time and describe the need for Einstein's Special Theory of Relativity.
- To analyze the geometric structure of space-time, including past, present, and future null cones, and interpret their physical significance in relativistic physics. Also to derive Maxwell's equations in tensor form and interpret the electromagnetic field tensor and energy-momentum tensor of the electromagnetic field.

Unit	Content
Unit I	Newtonian Mechanics Overview: Inertial frames, Speed of light and Galilean relativity, Relative character of space and time, Postulates of Special theory of relativity, Lorentz Transformation and its geometrical interpretation. Group properties of transformation. **(07 Hrs.)**

Unit II	Relativistic Physical Transformations: Composition of parallel velocities, Length contraction, Time Dilation, Transformation equation for components of velocities and acceleration of a particle, Lorentz contraction factor, The thermodynamics of moving systems: The two laws of thermodynamics for a moving system, The Lorentz transformation for thermodynamics quantities a) volume and pressure b) energy c) work d) heat e) entropy f) temperature. (**08 Hrs.)**
Unit III	Relativistic Space-time Structure: Four-dimensional Minkowskian space-time of relativity, Time like and space like intervals, Proper time, World line, Four vectors and tensors in Minkowskian space-time, Past, Present and future null cone, Basic tensors, Covariant, Contravariant, Mixed, Operations on tensors, Outer product, Inner product, Quotient law. **(07 Hrs.)**
Unit IV	Relativistic Electrodynamics: Variation of mass velocity, Equivalence of mass and energy, Transformation equations for mass, momentum and energy, Relativistic force and transformation equations for its components, Different forms of Maxwell's equations, Transformation of four potential vector charged density and current density, Lagrangian and Hamiltonian for charged particles, Lorentz force equation, Gauge transformation, Maxwell's equation in tensor form, Electromagnetic field tensor, energy momentum tensor of the electromagnetic field. **(08 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO1: To study Lorentz transformation and its geometrical interpretation.
CO2: To learn two laws of thermodynamics for a moving system.
CO3: To study geometrical representation of space-time and various tensors.
CO4: To learn energy momentum tensor and transformation equation.
CO5: To study Maxwell's equation of electromagnetic theory.

Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Text Book of Special Theory of Relativity: V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, K. R. Mule, C. S. Khodre, A. R. Gupta, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, V. J. Gaikwad, K. R. Mule, C. S. Khodre, A. R. Gupta : A Text Book of Special Theory of Relativity, Dnyanpath Publication, Amravati, Second edition 2024.
2] J. K. Goyal & K. P. Gupta: Theory of Relativity, Krishna Prakashan, Meerut.
3] C. Molar : The Theory of Relativity, Oxford Clarendon Press, 1952.
4] P. G. Bergman : Introduction to The Theory of Relativity, Prentice Hall of India, Pvt.Ltd.1969.
5] J. L. Anderson : Principles of Relativity Physics, Academic Press, 1967.
6] V. A. Ugarov : Special Theory of Relativity, Mir Publishers, 1979.
7] R. Resnick : Introduction to Special Relativity Wiley Eastern, Pvt.Ltd.1972.

Program: B. Sc.- III (Mathematics) Semester - V

Course Code / Subject: **126250** / Mathematics

The Vertical/ Type of Course: Major (Elective) / Lab Course – 21

Course Name: Practical Based on Special Theory of Relativity (126249)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- Study Lorentz transformations and interpret the geometrical structure of space and time within the framework of Special Theory of Relativity and to investigate the Lorentz transformation of thermodynamic quantities-volume, pressure, energy, work, heat, entropy, and temperature for systems in uniform motion.

- Study the Minkowskian space-time structure and distinguish between time-like, space-like, and null intervals, and calculate proper time. Also to examine the relativistic variation of mass with velocity and derive the relativistic relationships for energy and momentum.

Course Outcomes:

After successful completion of this course students will able to:

CO1: To demonstrate that Lorentz transformations form a mathematical group and explain the physical significance of their group properties.

CO2: Apply Lorentz transformations to interpret the geometrical structure of space and time in Special Theory of Relativity.

CO3: Apply the concept of four-vectors to analyze relativistic motion and interpret causal structure using past, present, and future null cones.

CO4: Derive and apply relativistic expressions for mass, energy, and momentum, and analyze their dependence on velocity.

CO5: Formulate and solve problems involving relativistic force, including the Lorentz force equation, and apply Lorentz transformations to electromagnetic four-potential, charge density, and current density.

Sr. No.	List of Practical's to be covered	No. of Examples
Practical Based on Special Theory of Relativity (126249)		
Practical Based on Group A		
1	To verify that Lorentz transformations form a mathematical group and understand their physical significance.	03
2	To study Lorentz transformations and understand the geometrical interpretation of space and time in Special Relativity.	03
3	To study inertial frames of reference and verify the principle of Galilean relativity using classical velocity transformation.	03
4	To study relativistic composition of parallel velocities and verify time dilation and length contraction using Lorentz transformations.	03
5	To derive and study transformation equations for velocity and acceleration components of a particle under Lorentz transformations.	03
6	To study Lorentz transformations of thermodynamic quantities such as volume, pressure, energy, work, heat, entropy, and temperature in moving systems.	03
	Practical Based on Group B	
1	To study Minkowskian space-time structure and distinguish between time-like, space-like, and null intervals, and to calculate proper time.	03
2	To study four-vectors in Minkowskian space-time and analyse causal structure using past, present, and future null cones.	03
3	To study tensor formalism in Minkowskian space-time including tensor types, operations, and quotient law.	03
4	To study variation of mass with velocity and derive relativistic relations for energy and momentum.	03
5	To study relativistic force, Lorentz force equation, and transformation of electromagnetic four-potential, charge density, and current density.	03
6	To study Maxwell's equations in tensor form, electromagnetic field tensor, gauge transformation, and energy-momentum tensor of electromagnetic field.	03

Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**

Practical Book:

A Practical Book based on Special Theory of Relativity: V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, K. R. Mule, C. S. Khodre, A. R. Gupta, R. M. Kamble, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, K. R. Mule, C. S. Khodre, A. R. Gupta: A Text Book of Special Theory of Relativity, Dnyanpath Publication, Amravati, First edition 2026.
2] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, V. J. Gaikwad, K. R. Mule, C. S. Khodre, A. R. Gupta : A Text Book of Special Theory of Relativity, Dnyanpath Publication, Amravati, Second edition 2024.
3] J. K. Goyal & K. P. Gupta: Theory of Relativity, Krishna Prakashan, Meerut.
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5] P. G. Bergman : Introduction to The Theory of Relativity, Prentice Hall of India, Pvt.Ltd.1969.
6] J. L. Anderson : Principles of Relativity Physics, Academic Press, 1967.
7] V. A. Ugarov : Special Theory of Relativity, Mir Publishers, 1979.
8] R. Resnick : Introduction to Special Relativity Wiley Eastern, Pvt.Ltd.1972.

Program: B. Sc.- III (Mathematics) Semester - VI

Course Code / Subject: **126251** / Mathematics

The Vertical/ Type of Course: Minor / Theory -4

Course Name: Complex Calculus and Partial Differential Equations

Total Number of Hours / Week: 2 Hrs.

Course Objectives:

- Classify and solve first-order partial differential equations, including total differential (Pfaffian) equations. Apply Lagrange's method and Charpit's general method to obtain solutions of first-order linear partial differential equations and complete integrals of non-linear first-order partial differential equations respectively.

- Understand the concepts of continuity, differentiability and analyticity of complex functions and distinguish them from their real-variable counterparts. Also to understand and apply conformal mapping techniques to analyse geometric transformations and solve mapping problems.

Unit	**Content**
Unit I	First Order PDE: Formation of PDE, Partial Differential equation of the first order, Total Differential Equation (Pfaffian), Lagrange's method. **(08 Hrs.)**
Unit II	Second Order PDE: Compatible Differential equation, Charpit's general method of solutions, Partial Differential equation of second and higher order. **(07 Hrs.)**
Unit III	Analytic Function: Continuity and differentiability of complex function, Analytic function, Cauchy-Riemann equations, Harmonic and conjugate functions, Milne-Thomson method. **(08 Hrs.)**

Unit IV	Transformations: Elementary function, Mapping by elementary function, Mobius transformation, Fixed point, Cross ratio, Inverse and critical points, Conformal mapping. (**07 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO1: To formulate partial differential equations from given physical or mathematical situations.

CO2: To solve and analyze partial differential equations of second and higher orders using standard analytical techniques.

CO3: Apply the Cauchy–Riemann equations to determine analyticity of complex functions and construct harmonic and conjugate functions.

CO4: Use conformal mapping techniques to solve problems involving geometric transformations in the complex plane.

Internal Assessment **(20 Marks)**	**1.** Two CAT (Continuous Assessment Test) **(10 Marks each)** a. CAT- I : MCQ's based b. CAT - II : Descriptive based (Consider best of one for Internal Assessment) **2.** Seminar / Group Discussion / Book Review (**05 Marks)** **3.** Field Work / Quiz / Mini Project Work / Attendance **(05 Marks)**

Text Book:

A Text Book of Complex Calculus and Partial Differential Equations: V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, V. D. Elkar, T. D. Nakade, A. P. Jenekar, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, S. R. Kumbhare, T. D. Nakade, S. H. Shaikh: A Textbook of Partial Differential Equations, Dnyanpath Publication, Amravati, First edition 2026.

2] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, R. M. Dhaigude : A Textbook of Mathematical Analysis, Dnyanpath Publication, Amravati, First edition 2026.

3] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, S. R. Kumbhare, T. D. Nakade, S. H. Shaikh: A Text Book of Partial Differential Equation, Dnyanpath publication, Amravati, First Edition 2023.

4] V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari: A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, Second edition 2024.

5] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, V. J. Gaikwad, R. M. Dhaigude : A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, First edition 2022.

6] Murray D.A.: Introductory course in Differential Equations, Orient Longman (India), 1967.

7] Erwin, Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 1999.

8] Piaggio HTS: Differential Equations, CBS Publishers &Distributors, Delhi, 1985.

9] Siminons G.F. : Differential Equations, Tata McGraw Hill, 1972.

10] A.R. Forsyth. A Treatise on Differential Equations, Macmillan and Co. Ltd. London.

11] Ian N., Sneddon, Elements of Partial Differential Equations. McGraw-Hill Book Company, 1988.

12] Jane Cronin. Differential equations, Marcel Dekker, 1994.

13] Richard Bronson, Theory and Problems of Differential Equations, McGraw Hill Inc, 1973.

14] R. R. Goldberg: Methods of Real Analysis, Oxford IBH publishing Co. New Delhi, 1970.

15] Walter Rudin: Principles of Mathematical Analysis, International student's edition (Third edition)

16] T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.,

17] S. Lang : Undergraduate Analysis, Springer-Verlag New York, 1983.

18] D. Somasundaram & B. Choudhari : A First Course in Mathematical Analysis, New Delhi. 1997.

19] Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.

20] Mark J Ablowitz and : A.S. Fokas, Complex Variable Introduction and Application, Cambridge University Press, South Asian Edition, 1998.

21] Shanti Narayan: Theory of functions of Complex Variable, S. Chand and Co. New Delhi.

22] S. C. Malik and Arora : Mathematical Analysis, Wiley Estern Ltd., New Delhi.

Program: B. Sc.- III (Mathematics) Semester - VI

Course Code / Subject: 126252 / Mathematics

The Vertical/ Type of Course: Minor / Lab Course – 22

Course Name: Practical Based on Complex Calculus and Partial Differential Equations **(**126251)

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- Form first-order partial differential equations by eliminating arbitrary constants and to solve first-order linear partial differential equations using Lagrange's method and Charpit's method**.**
- To verify the analyticity of complex functions using the Cauchy–Riemann equations. And to construct analytic functions using the Milne–Thomson method.

Course Outcomes:

After successful completion of this course students will able to:

CO1: Apply various methods to solve special types of first-order partial differential equations.

CO2: Classify second-order partial differential equations as elliptic, parabolic, or hyperbolic.

CO3: Determine harmonic conjugates of given harmonic functions and construct corresponding analytic functions.

CO4: To analyze analytic functions and to determine their zeros, singularities, and poles.

CO5: Classify Möbius transformations as elliptic, parabolic, or hyperbolic based on their fixed points and properties.

Sr. No.	List of Practical's to be covered	No. of Examples
Practical Based on Complex Calculus and Partial Differential Equations (126251)		
	Practical Based on Group A	
1	To form first order partial differential equations by elimination of arbitrary constants.	03
2	To solve first order linear partial differential equations by using Lagrange's method	03
3	To solve some special type of equation by general methods.	03
4	To solve the first order partial differential equations by using Charpit's method	03
5	To verify the differential equation is compatible or not	03
6	To classify the partial differential equations into elliptic, parabolic and hyperbolic	03
	Practical Based on Group B	
1	To verify analyticity of a function using Cauchy-Riemann equations	03
2	To find the harmonic conjugate of a given harmonic function	03
3	To construct an analytic function using Milne-Thomson method.	03
4	To determine zeros, singularities, and poles of analytic functions.	03
5	To find the fixed points of a Mobius transformation	03
6	To find and classify a given transformation as elliptic, parabolic, or hyperbolic.	03
Practical Assessment (50 Marks)	Internal Practical Assessment **(25 Marks)**	**1.** Practical Record- **15 Marks** **2.** Viva voce – **10 Marks**
	External Practical Assessment **(25 Marks)**	**1.** Practical Perform – **20 Marks** (Perform any two from each group A and B carry **05 Marks**) **2.** Viva voce- **05 Marks**

Practical Book:

A Practical Book based on Complex Calculus and Partial Differential Equations: V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, A. O. Dhore, P. R. Langade, S. L. Munde, M. S. Palaspagar, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] V. A. Sharma, G. U. Khapekar, V. R. Patil, S. R. Bhoyar, A. N. Rangari, V. D. Elkar, T. D. Nakade, A. P. Jenekar, : A Text Book of Complex Calculus and Partial Differential Equations: Dnyanpath Publication, Amravati, First edition 2026.

2] V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, S. R. Kumbhare, T. D. Nakade, S. H. Shaikh: A Textbook of Partial Differential Equations, Dnyanpath Publication, Amravati, First edition 2026.

3] V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, R. M. Dhaigude : A Textbook of Mathematical Analysis, Dnyanpath Publication, Amravati, First edition 2026.

4] V. A. Sharma, S. R. Bhoyar, V. R. Patil, G. U. Khapekar, S. R. Kumbhare, T. D. Nakade, S. H. Shaikh: A Text Book of Partial Differential Equation, Dnyanpath publication, Amravati, First Edition 2023.

5] V. A. Sharma, G. U. Khapekar, S. R. Bhoyar, V. R. Patil, A. N. Rangari: A Text Book of Mathematical Analysis, Dnyanpath Publication, Amravati, Second edition 2024.

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7] Murray D.A.: Introductory course in Differential Equations, Orient Longman (India), 1967.

8] Erwin, Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 1999.

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10] Siminons G.F. : Differential Equations, Tata McGraw Hill, 1972.

11] A.R. Forsyth. A Treatise on Differential Equations, Macmillan and Co. Ltd. London.

12] Ian N., Sneddon, Elements of Partial Differential Equations. McGraw-Hill Book Company, 1988.

13] Jane Cronin. Differential equations, Marcel Dekker, 1994.

14] Richard Bronson, Theory and Problems of Differential Equations, McGraw Hill Inc, 1973.

15] R. R. Goldberg: Methods of Real Analysis, Oxford IBH publishing Co. New Delhi, 1970.

16] Walter Rudin: Principles of Mathematical Analysis, International student's edition (Third edition)

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19] D. Somasundaram & B. Choudhari : A First Course in Mathematical Analysis, New Delhi. 1997.

20] Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.

21] Mark J Ablowitz and : A.S. Fokas, Complex Variable Introduction and Application, Cambridge University Press, South Asian Edition, 1998.

22] Shanti Narayan: Theory of functions of Complex Variable, S. Chand and Co. New Delhi.

23] S. C. Malik and Arora : Mathematical Analysis, Wiley Estern Ltd., New Delhi.

Program: B. Sc.- III (Mathematics) Semester - VI

Course Code / Subject: 126253 / Mathematics

The Vertical/ Type of Course: VSC (Vocational Skill Course) / Lab Course-23

Course Name: Math Type – Equation Editor

Total Number of Hours / Week: 4 Hrs.

Course Objectives:

- Familiarize students with Math Type software for professional mathematical typesetting and enable students to create, edit, and format mathematical equations and symbols efficiently.
- Train students to integrate Math Type equations with word processors and LaTeX documents and to prepare students for academic and research documentation involving complex mathematical notation.

Unit	Content
Unit I	Math Type Interface Basics: Overview of Math Type and its applications, Installation and system requirements, Understanding the Math Type workspace, Toolbars, palettes, and menus, Symbol and template panels, Basic navigation and shortcuts. **(07 Hrs.)**
Unit II	Basic Mathematical Expressions: Typing simple expressions (fractions, powers, sub/superscripts), Creating roots, exponents, and indices, using templates for summations, integrals, limits, Polynomials and algebraic expressions, Trigonometric functions and identities, Logarithmic and exponential functions, Matrices and determinants, Equation alignment and numbering, aligning multi-line equations, Spacing & formatting tools, using keyboard shortcuts for faster input, text within equations **(08 Hrs.)**
Unit III	Calculus and Advanced Mathematics: Limits and continuity notation, Differentiation and partial derivatives, Integrals (definite and indefinite), Summation and product notation, Vector calculus symbols, Complex numbers and functions, Greek symbols and special notations, Differential equations notation, Laplace and Fourier transform symbols **(07 Hrs.)**
Unit IV	Working with Word Processors: Insert equations into Microsoft Word or Google Docs, Inline vs display equations, editing equations already placed in documents, managing equation numbering, Using Math Type with MS Word and LaTeX, Converting Math Type equations to LaTeX, Editing and revising equations, Exporting equations for presentations **(08 Hrs.)**

Course Outcomes:

After successful completion of this course students will able to:

CO1: Use Math Type efficiently for mathematical documentation.
CO2: Create and edit complex mathematical expressions.
CO3: Integrate equations into Word and LaTeX documents.
CO4: Prepare professional-quality assignments, projects, and research reports.
CO5: Develop skills to type algebraic, trigonometric, calculus, and advanced mathematical expressions accurately.
CO6: Improve the quality and presentation of assignments, project reports, question papers, and research documents.

Practical Book:

Practical Book on Math Type – Equation Editor: V. A. Sharma, S. R. Bhoyar, G. U. Khapekar, V. R. Patil, A. N. Rangari, N. G. Ghungarwar, S. M. Shingane, S. P. Gaikwad, R. A. Wasnik, Dnyanpath Publication, Amravati, First edition 2026.

Reference Books:

1] “LaTeX: A Document Preparation System” — Leslie Lamport, Great for understanding how Math Type works with LaTeX.
2] “The LaTeX Companion” — Frank Mittelbach & Michel Goossens, Useful for advanced equation formatting.
3] “Math Type User’s Guide” — Design Science, Official manual covering tools, symbols, menus, and integration.
4] “Math Type for Scientific and Mathematical Writing”, Practical guide for students and researchers.
5] MathType-tipstricks-full.pdf https://share.google/WAG1qG5TyaLOvox3n
6] IEEE-Math-Typesetting-Guide-for-MS-Word-Users.pdf https://share.google/92Rxm9xyMk0UjqlHI.
7] https://www.scribd.com/doc/282613435/183007584-MathType.

Sr. No.	List of Practical’s to be covered
	Practical Based on Group A
1	To create basic mathematical symbols and operators.
2	Typing superscripts, subscripts, fractions, and powers.
3	To working with brackets, delimiters, and nested expressions.

4	To prepare algebraic expressions and polynomial equations
5	To type trigonometric functions and identities.
6	To create matrices and determinants of different orders
Practical Based on Group B	
1	To type limits and continuity expressions.
2	To create differentiation and partial derivative notation.
3	To Type definite, indefinite, and multiple integrals.
4	To create summation and product notations.
5	To type complex numbers and differential equations
6	To convert Math Type equations to LaTeX format.
Internal Practical Assessment (50 Marks)	**1.** Practical Perform – **30 Marks** (Perform any one from group A and B, each carry **15 marks**) **2.** Practical Record- **10 Marks** **3.** Viva voce– **10 Marks**

Examination, Evaluation and Assessment Scheme

Vertical No.	The Vertical	Mode of Examination, Evaluation & Assessment	Theory				Theory (Total)		Practical				Practical (Total)	
			External		Internal				External		Internal			
			Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
a	Major	External & Internal	**30**	**9**	**20**	**6**	**50**	**20**	**25**	**10**	**25**	**10**	**50**	**20**
b	Minor		**30**	**9**	**20**	**6**	**50**	**20**	**25**	**10**	**25**	**10**	**50**	**20**
c	Generic/ Open Elective	Internal	--	--	**50**	**20**	**50**	**20**	--	--	--	--	--	--
d	VSC	Internal	--	--	--	--	--	--	--	--	**50**	**20**	**50**	**20**
	SEC	Internal	--	--	--	--	--	--	--	--	**50**	**20**	**50**	**20**
e	AEC (Eng. & One MIL Composite)	Internal	--	--	**50**	**20**	**50**	**20**	--	--	--	--	--	--
	IKS (Generic)	Internal	--	--	**50**	**20**	**50**	**20**	--	--	--	--	--	--
	VEC	Internal	--	--	--	--	--	--	--	--	--	--	--	--
f	Internship/ Apprenticeship FP/CEP CC	Internal	Assessment of these verticals shall be based on various activities/practices. The evaluation/assessment shall be done by appointing external examiner by principal from Industry/Organization/Academia. The mentor faculty shall be the internal examiner. It shall be evaluated by giving maximum 50 marks per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately.											

Appendix-A

INSTRUCTIONS FOR THE PAPER SETTERS
2026-27
Subject: Mathematics

External University Examination

Sr. No	Program	Marks of theory paper	Internal Marks	Total	Instructions
1	UG – NEP (Mathematics) Major/Minor/Elective	30	20	50	Total Units: 04 **(Two units for 08 Marks and Two units for 07 Marks)**
	SEM V AND SEM VI				**Paper setting for 08 Marks:** Question 1. a) 04 Marks OR b) 04 Marks Question 1. c) 04 Marks OR d) 04 Marks **Paper setting for 07 Marks:** Question 2. a) 04 Marks OR b) 04 Marks Question 2. c) 03 Marks OR d) 03Marks

Note: For the subject Mathematics, the strength of the batch of the practical for UG classes shall be of 16 students with an addition of 10% with the permission of Honourable Vice Chancellor. (As per NEP-2020 Scheme of SGBAU, Amravati, A-1686).

Model Question Paper
Major/Minor
B.Sc. (Part III) Semester V (NEP) Examination
Course Code: 126230
Major Theory – 8
Mathematical Analysis

Time: 2 Hours **Maximum Marks: 30**

Note: 1. In each unit solve (a) or (b) and (c) or (d).

UNIT I

Q. 1. a) Prove that if $w = f(z) = u(x, y) + iv(x, y)$ is analytic function in a region D, then $u_x = v_y$ *and* $u_y = -v_x$ in D. **4**

OR

b) If $f(z)$ is analytic, then show that $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)|f(z)|^2 = 4|f'(z)|^2$. **4**

c) Show that an analytic function with constant modulus is constant. **4**

OR

d) Show that the function $u = x^3 - 3xy^2$ is harmonic and find the corresponding analytic function **4**

UNIT II

Q. 2. a) Show that the cross ratio remains invariant under a bilinear transformation. **4**

OR

b) Find the fixed points of the transformation $w = \frac{z-1}{z+1}$. State whether it is hyperbolic, elliptic or loxodromic? **4**

c) Show that every bilinear transformation with two non-infinite fixed points α, β is of the form $\frac{w-\alpha}{w-\beta} = k\frac{z-\alpha}{z-\beta}$ where k is a constant. **3**

OR

d) Show that $w = \frac{1}{z}$ maps the circle $|z-3| = 5$ onto $\left|w + \frac{3}{16}\right| = \frac{5}{16}$. **3**

UNIT III

Q. 3. a) If f be a bounded real function defined on $[a, b]$, then prove that refinement of a partition P increases lower sums and decreases upper sums
i. e. $L(P, f) \le L(P^*, f)$ *and* $U(P, f) \ge U(P^*, f)$ **4**

OR

b) If f is a function defined by $f(x) = x$ *on* $[0, 2]$, then show that f is integrable in Riemann sense over $[0, 2]$ and $\int_0^2 f(x)\,dx = 2$. **4**

c) Let the bounded function f be defined as
$f(x) = 1$, *when x is rational*
$= -1$ *when x is irrational*
Show that f is not R-integrable over $[0, 1]$ but $|f| \in R[0, 1]$ **4**

OR

d) If f is a bounded and integrable function over $[a, b]$ and M, m are the bounds of f over $[a, b]$, then prove that $m(b-a) \le \int_a^b f(x)\,dx \le M(b-a)$. **4**

UNIT IV

Q. 4. a) Prove that every neighborhood is an open set. **4**

OR

b) Let X be an arbitrary non empty set. Define d by $d(x, y) = 1, \quad x \neq y$
$= 0, \quad x = y$.

Show that d is discrete metric on X **4**

c) Prove that every convergent sequence in a metric space (X, d) is a Cauchy sequence. **3**

OR

d) Show that the function $d(x, y) = \sqrt{|x - y|}$, $\forall\, x, y \in R,$ defines a metric on R. **3**

****