Name of Teacher- Mr Arvind Shankarrao Salve

Programme (Name) - B. Sc. Code-

Programme Specific Name-B. Sc. in Mathematics Code-

| Sr. No. | Course Name | Course code | Class |
|---|---|---|---|
| 1 | Algebra I & Calculus I | USMT101 | F. Y. B. Sc. |
| 2 | Basic in Python Programming | | |
| 3 | Discrete Mathematics & Calculus II | USMT201 | F. Y. B. Sc. |
| 4 | Computing with Python | | |
| 5 | Indian Mathematics | Major | S. Y. B. Sc. |
| 6 | Vector Spaces | Minor | S. Y. B. Sc. |
| 7 | PM-3B Vector Spaces | Minor | |
| 8 | Linear Algebra II | Major | S. Y. B. Sc. |
| 9 | Linear Algebra | Minor | S. Y. B. Sc. |
| 10 | PM-4BLinear Algebra | Minor | S. Y. B. Sc. |
| 11 | Group Theory | USMT502 | T. Y. B. Sc. |
| 12 | Partial Differential Equations | USMT5A4 | T. Y. B. Sc. |
| 13 | Ring Theory | USMT602 | T. Y. B. Sc. |
| 14 | Integral Transform | USMT6A4 | T. Y. B. Sc. |

## Course outcome (2025-26)-

| Sr. No. | Course Name | Course code | Outcomes |
|---|---|---|---|
| | | | **FYBSc** |
| 1 | Algebra I and Calculus I | Major | 1. Understand the real number system, differential equations, the integer and rational number system and illustrate examples of polynomials.<br>2. explain the properties and theorems of polynomials with suitable examples and also explain the concepts of modulus, infimum and supremum.<br>3. verify the concepts related to sequences, like bounded, convergent, divergent, Cauchy, etc. and also to verify the statements of theorems by applying them in problem-solving. |

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| | | | 4. evaluate the limits of convergent sequences and find solutions of differential equations.<br>5. apply differential equations to solve problems related to population growth and develop an understanding of the abstract part of algebra required for higher order thinking in pure mathematics in the higher classes.<br>6. construct counter examples related to bounded sets, bounded sequence, Cauchy sequence and convergent sequence. |
| 2 | Basic in Python Programming | VSC | 1.To learn and understand algorithms.<br>2. To define the structure and components of algorithm and python program.<br>3. To learn and understand python looping and control statements manipulations.<br>4. To learn about inbuilt input/output operations and compound data types in Python<br>5. To learn about searching, sorting and recursion with python programming. |
| 3 | Discrete Mathematics & Calculus II | Major | 1. understand the concepts of limit and continuity of functions and various counting techniques which are used to handle problems on finite sets and apply them in day-to-day life.<br>2. explain the concept differentiability of a function, addition and multiplication principles, two-way counting, inclusion and exclusion principles.<br>3. apply the derivatives and obtain maxima/minima of functions and other various applications, also mathematical logic to solve problems.<br>4. verify existence of limit, continuity and differentiability of a function.<br>5. find the limits and derivatives and the number of partitions using Sterling numbers.<br>6. construct counter examples related to continuous and discontinuous functions etc. and design problems based on the pigeonhole principle. |
| 4 | Computing with Python | VSC | 1.To understand why Python is a useful scripting language for developers.<br>2. To learn how to use lists, tuples, and dictionaries in Python programs.<br>3. To learn how to use indexing and slicing to access data in Python programs.<br>4. To develop the skill of designing Mathematical user Interfaces with SymPy package in Python<br>5. To develop SymPy code for different areas of mathematical concepts including calculus, plotting graphs, derivatives and solving simultaneous equations. |
| **SYBSc** | | | |
| 5 | Indian Mathematics | Major (IKS) | 1. understand and recall the methods of obtaining square roots and cube roots, results related radius and diameter and the contributions of Indian Mathematicians<br>2. explain Pythagorean triplets as appeared in Shulbasootras, impossibility of square root of negative numbers, expressed by Indian mathematicians, Varga-Sankramana, etc.<br>3. apply Indian ancient methods to find squares and cubes, volume of a sphere given by Bhaskaracharya, volume of pyramid given by Brahmagupta etc.<br>4. analyse the problem of Kuttaka and the methods given by Brahmagupta and Bhaskaracharya, the problem of Varga Prakriti and the method given by Bhaskaracharya.<br>5. create counter examples Pythagorean triplets. |
| 6 | Vector Spaces | Minor | After completion of the course, students will be able to<br>1. Understand, remember the concepts and properties vector spaces.<br>2. Apply the formulas and the concepts to solve examples subspaces, sum and intersection of subspaces. |

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| | | | 3. To analyse the properties of vector spaces, row space and column space of a matrix<br>4. Justify or check a set to be a vector space.<br>5. Construct counterexamples related to vector spaces and subspaces. |
| 7 | PM-3B Vector Spaces | Minor | 1. Apply the formulas and the concepts to solve examples related to vector spaces.<br>2. To analyse and test the property of vector subspaces on sets.<br>3. To check linear independence, and dependence of vectors.<br>4. Construct basis and counter-examples related to vector spaces and subspaces. |
| 8 | Linear Algebra II | Major | 1. Understand basis of vector space, linear transformations, kernel, image, rank, nullity, associated matrices, inner product spaces, orthogonality of vectors and diagonalization of matrix.<br>2. Apply the Cayley-Hamilton theorem to find inverse, power of matrix and Gram-Schmidt orthogonalization process to find orthogonal/orthonormal sets.<br>3. Analyse diagonalizable matrices, orthogonally diagonalizable matrices, conic sections, and verify linear isomorphism, rank-nullity theorem for linear transformations, Cauchy Schwarz inequality, triangle inequality.<br>4. Evaluate kernel, image, eigenvalues, eigenvectors, algebraic multiplicity, geometric multiplicity, angle between vectors and orthogonal complement of subspace.<br>5. Construct linear isomorphism between given vector spaces, non-diagonalizable matrix, quadratic forms and matrix with given eigenvalues. |
| 9 | Linear Algebra | Minor | 1: Remember and understand the concept of a system of linear equations, matrices and linear transformations<br>2. Calculate and find the solutions to a system of equations using various methods, finding the inverse of matrices<br>3. Analyse the linear transformation and its various aspects<br>4. Verify the Rank Nullity theorem<br>5. Construct counterexamples related to linear transformations |
| 10 | PM-4B Linear Algebra | Minor | 1. Calculate solutions to a system of equations using various methods, and the inverse of matrices<br>2. Analyse the null space and rank space related to the linear transformation.<br>3. Verify the Rank Nullity theorem<br>4. Construct and design counterexamples related to linear transformations |
| **TYBSc** | | | |
| 11 | Group Theory | USMT 502 | 1. Definition and elementary properties of a group, Subgroups, criterion for subgroup. Abelian group, centre of group. Homomorphism and isomorphism.<br>2. Example of groups including Z, Q, R, C, Klein 4-group, symmetric and alternating groups, S1, GLn(R), SLn(R) and group of symmetries of plane figures. Order of element, Subgroup generated by a subset of the group.<br>3.Coset of a subgroup, Lagrange's Theorem, Normal Subgroup, Alternating group. Quotient group, External direct products of groups, Cayley's Theorem for finite groups.<br>4. Examples of cyclic groups, properties of cyclic groups, finite cyclic groups, infinite cyclic groups and their generators, Properties of generators. |
| 12 | Partial Differential Equations | USMT 5A4 | 1. Curves and Surfaces, Genesis of first order pde, Classification of first order pde, Cauchy problem, Lagrange's equation, Pfaffian differential equation<br>2. Necessary and sufficient condition of integrability, Charpit's method, Some standard types, Jacobi's method, The Cauchy Problem<br>3. Semi-linear equations, Quasi-linear equations, first order quasi-linear pde, Initial Valued Problem for quasi linear equation, Non-linear first order pde, Monge cone, Analytic expression for Monge cone, characteristics strip. |

| S. N. | Course Name | Course code | Outcomes |
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| 13 | Ring Theory | USMT 602 | 1.Definition and elementary properties of ring, commutative rings, integral domain and fields examples. Units in ring, Characteristics of ring and examples.<br>2. Ideals in ring, Sum and products of ideals, quotient rings and examples. Prime ideals and maximal ideals. Characterization of prime ideals and maximal ideals in commutative ring, homomorphism and isomorphism of rings<br>3. Divisibility in a ring, Irreducible and prime elements, Division algorithm, Monic polynomials, greatest common divisor and examples of irreducible polynomials, Eigenstein criterion. |
| 14 | Integral Transform | USMT 6A4 | 1. Definition of Laplace transform, properties, derivatives and integrals, Inverse Laplace transform and its properties, convolution theorem, Inverse LT by partial fraction method.<br>2. Fourier integral representation, fourier integral transform, fourier sine & cosine integral representation, Fourier Sine and Cosine transform pairs, FT of elementary functions, properties of fourier transform, convolution theorem.<br>3. Relation between the Fourier and Laplace transform. Application of laplace transform to evaluation of integrals and solutions of higher order ode. Application of LT to solution of one dimensional heat equation & wave equation. Application of Fourier transform to the solution of initial and boundary value problem. |

I/C Principal
Shikshak Sanchalit Shikshan Sansthe's
Dr. Shantilal Dhanji Devsey Arts College &
Commerce & Science College, Wada, Dist. Palghar

**Sachin Vithalrao Bedre (M. Sc., Ph. D.)**
*Assistant Professor in Mathematics,*
Department of Mathematics,
Dr. S. D. D. Arts College and Commerce and Science College, Wada

Course outcomes

A.Y.2025-26

## Program Specific outcomes of B.Sc. in Mathematics:

After completion of B.Sc. in mathematics students are able to

1. Demonstrate a rigorous understanding of core theory of mathematics, which includes calculus, algebra, differential equation, metric topology, complex analysis and numerical methods.

2. Learn to solve multiple integral.

3. Understand the concept of metric topology.

4. Learn properties of analytic function.

## Course Outcomes:

**Year – 2025-26**

| Sr. No. | Course Name | Course code | Outcome |
|---|---|---|---|
| 1 | Multivariable Calculus II | USMT 501 | On completion of this unit successfully students will be to:<br>1. Solve double and tripled integrals<br>2. Handle Multiple, line and surface integral<br>3. Translate real life situations into symbolism of mathematics and find solution for the resulting models |
| 2 | Topology of Metric Spaces | USMT 503 | On completion of this unit successfully students will be to:<br>1. Deal with various examples of metric spaces |

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| | | | 2. Have some familiarity with open and closed sets.<br>3. Work with compact sets inEuclidean spaces |
| 3 | Elements Of Operations Research – I | USACOR501 | On completion of this unit successfully students will be to:<br>1.Solve LPP problems using graphical method, Simplex method and Big-M method etc<br>2. Handle Dual Simplex Method<br>3. Have some familiarity with Uniform, Binomial, Poisson, Exponential, Normal Distribution |
| 4 | Practical based on USMT501 | USMTP05 | On completion of this unit successfully students will be to:<br>1. Solve double and tripled integrals<br>2. Handle Multiple, line and surface integral<br>3. Translate real life situations into symbolism of mathematics and find solution for the resulting models |
| 5 | Practical based on USMT503 | USMTP06 | On completion of this unit successfully students will be to:<br>1. Deal with various examples of metric spaces<br>2. Have some familiarity with open and closed sets.<br>3. Work with compact sets inEuclidean spaces |
| 6 | Practical based on USACOR501 | USACOR5P1 | On completion of this unit successfully students will be to:<br>1.Solve LPP problems using graphical method, Simplex method and Big-M method etc |

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| | | | 2. Handle Dual Simplex Method<br>3. Have some familiarity with Uniform, Binomial, Poisson, Exponential, Normal Distribution |
| 7 | Basic Complex Analysis | USMT 601 | On completion of this unit successfully students will be to:<br>1. Explain the fundamental concepts of complex analysis and their role in modern mathematics and applied contexts<br>2. Apply problem solving using complex analysis techniques applied to diverse situations in physics, engineering and other mathematical contexts |
| 8 | Topology of Metric Spaces and Real Analysis | USMT 603 | On completion of this unit successfully students will be to:<br>1. Demonstrate accurate and efficient use of Metric Spaces techniques.<br>2. Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concept from metric spaces<br>3. Apply the ideas of metric spaces to other areas of mathematics |
| 9 | Elements Of Operations Research – II | USACOR601 | On completion of this unit successfully students will able to:<br>1. Take decision under uncertainty using Laplace criterion, Maximax (Minimin) criterion etc.<br>2. Have familiarity with Simple and compound interest |

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| | | | 3) Understand stock market. |
| 10 | Practical based on USMT601 | USMTP07 | On completion of this unit successfully students will be to:<br>1. Explain the fundamental concepts of complex analysis and their role in modern mathematics and applied contexts<br>2. Apply problem solving using complex analysis techniques applied to diverse situations in physics, engineering and other mathematical contexts |
| 11 | Practical based on USMT603 | USMTP08 | On completion of this unit successfully students will be to:<br>1. Demonstrate accurate and efficient use of Metric Spaces techniques.<br>2. Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concept from metric spaces<br>3. Apply the ideas of metric spaces to other areas of mathematics |
| 12 | Practical based on USACOR601 | USACOR6P1 | On completion of this unit successfully students will able to:<br>1. Take decision under uncertainty using Laplace criterion, Maximax (Minimin) criterion etc.<br>2. Have familiarity with Simple and compound interest<br>3) Understand stock market. |

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| 13 | Real Analysis and Linear Algebra - I | Major 1 | On completion of this unit successfully students will able to:<br>1. Understand and remember the concepts such as convergence/ divergence of series, Riemann Integration, beta-gamma functions, rank of matrix and related results.<br>2. Apply the formulae and concepts to solve the examples related to series, Riemann Integral, area between two curves, system of linear equations etc.<br>3. Analyze the convergence and divergence of series and inerrability of given function and examine and interpret the conditions of consistency of systems of linear equations, subspaces of vector spaces, and equivalence of row rank and column rank.<br>4. Justify/check the inerrability of function, absolute and conditional convergence of series.<br>5. Construct counter examples related to absolutely convergent/ divergent series, non integrable functions consistent and inconsistent systems, elementary matrices, subspaces, and related to properties of vector spaces. |

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| 14 | Real Analysis and Linear Algebra- I | P-3 | On completion of this unit successfully students will able to:<br>1. Apply the formulae and concepts to solve the examples related to series, Riemann Integral, area between two curves, Gaussian elimination method etc.<br>2. Analyze the convergence and divergence of series and integrability of given function and explore the fundamental properties of vector spaces and subspaces, including their intersections, unions, sums, and direct sums.<br>3. Justify/ check the inerrability of function, absolute and conditional convergence of series and examine and evaluate linear combinations, linear spans, and linear dependence and independence in vector spaces.<br>4. Construct counter examples related to absolutely convergent/ divergent series, non-integrable functions etc. and formulate and validate results related to system of non-homogeneous linear equations and application of Cramer's rule. |
| 15 | JAVA Programming | SEC | On completion of this unit successfully students will able to: |

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| | | | 1. Apply Java's basic syntax, control structures, and standard libraries to write and analyze programs effectively.<br>2. Analyze and design Java programs that efficiently handle operations on arrays, matrices, and strings, applying appropriate algorithms for problem-solving.<br>3. Perform object-oriented programming concepts such as encapsulation, inheritance, and polymorphism in Java applications. |
| 16 | Multivariable Calculus and Ordinary Differential Equations | Major 1 | After completion of the course, students will be able<br>1. Understand and remember the concepts such as Euclidean spaces, norm, inner product, limit, continuity, derivatives of scalar fields various methods of solving higher order linear ordinary differential equations etc. 2. Apply first and second derivative tests to find extreme values of scalar fields and the methods of solving linear differential equations with constant coefficients.<br>3. Verify the relationship between Differentiability and Continuity, directional derivative and continuity etc. |

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| | | | 4. Check differentiability and continuity of scalar and vector fields and evaluate the complementary function and particular integral of given ordinary linear differential equations.<br>5. Create counter examples related to continuity and differentiability, directional derivative and continuity, partial derivatives, total derivative and ordinary differential equation for the given solution etc. |
| 17 | Multivariable Calculus, Linear Algebra II and Ordinary Differential Equations | P4 | On completion of this unit successfully students will able to:<br>1. Apply first and second derivative tests to find extreme values of scalar fields, compute eigenvalues and eigenvectors apply the Cayley-Hamilton theorem, and understand inner product spaces and related inequalities and also apply the various methods to solve ordinary linear differential equations.<br>2 verify the relationship between Differentiability and Continuity, directional derivative and continuity etc.<br>3. Check differentiability and continuity of scalar and vector fields and evaluate the complementary function and particular |

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| | | | integral of given ordinary linear differential equations.<br>4. Create counter examples related to continuity and differentiability, directional derivative and continuity, partial derivatives and total derivative etc and construct orthogonal and orthonormal sets using the Gram-Schmidt process and compute orthogonal complements of subspaces. |
| 18 | Advanced Python | VSC | After completion of the course, students will be able.<br>1. Apply NumPy, SciPy, Pandas, Matplotlib functions to solve numerical, statistical, optimization problems and System of equations.<br>2. Analyze clear and insightful data visualizations using these packages.<br>3. Perform numerical computations on multi-dimensional arrays using these packages.<br>4. Design programs for effective data manipulation, visualization, and analysis of small datasets. |
| 19 | Data Analytics I | SEC I | On completion of this unit successfully students will able to:<br>1. Remember and recall key statistical terminologies and concepts. |

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| | | | 2. Understand the foundational principles of statistics and data representation.<br>3. Apply statistical concepts and measures to real-world datasets.<br>4. Analyze data patterns, relationships, and distributions using statistical tools.<br>5. Evaluate statistical measures for different types of data and scenarios.<br>6. Develop the ability to create various graphical representations for qualitative and quantitative data. |
| 20 | Data Analytics II | SEC II | On completion of this unit successfully students will able to:<br>1. Recall advanced statistical terminologies, probability distributions, and the concepts of bivariate data.<br>2. Explain the foundational principles of correlation, linear regression, and inferential statistics.<br>3. Apply advanced analytical tools and functions in Excel or R software to manipulate complex datasets.<br>4. Analyze relationships, trends, and dependencies between multiple variables within a dataset.<br>5. Evaluate the strength of statistical models, regression lines, and |

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| | | | basic hypothesis tests for real-world scenarios.<br>6. Develop comprehensive data analysis reports, predictive models, and custom dashboards to convey analytical insights. |
| 21 | Practical Statistics for Commerce – I | SEC I | On completion of this unit successfully students will able to:<br>1. Understand the concept of central tendency, measures of dispersion and be able to calculate mean, median, mode, range, variance, and standard deviation for raw and grouped data.<br>2. Learn to compute measures of central tendency for both discrete and continuous random variables.<br>3. Analyze data variability using measures of dispersion.<br>4. Making situations, courses of action, and states of nature.<br>5. Construct pay-off matrices and use them for decision-making skills under uncertainty using techniques like Maximin, Maximax, Expected Monetary Value (EMV), Expected Opportunity Loss (EOL) and Laplace criteria. |
| 22 | Practical Statistics for Commerce – II | SEC II | On completion of this unit successfully students will able to:<br>1. Calculate cost of living index numbers and real income, thereby understanding their |

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| | | | practical implications in economic analysis and policy-making.<br>2. Understand the relationship between variables through correlation analysis and also, to explore the significance of index numbers related to economics and other fields.<br>3. Analyze scattered data and fit appropriate models using the Method of Least Squares.<br>4. Develop skills in time series analysis, including trend estimation and forecasting techniques.<br>5. Perform regression analysis effectively, including deriving regression lines and interpreting regression outputs. |