# Payyanur College, Payyanur (Affiliated to Kannur University)

# Programme Outcomes (POs)

# BSc DEGREE PROGRAMME (FOR SCIENCE)

## PROGRAMME OUTCOMES (PO)

**PO1. Critical Thinking:**

1.1. Acquire the ability to apply the basic tenets of logic and science to thoughts, actions and interventions.
1.2. Develop the ability to chart out a progressive direction for actions and interventions by learning to recognize the presence of hegemonic ideology within certain dominant notions.
1.3. Develop self-critical abilities and also the ability to view positions, problems and social issues from plural perspectives.

**PO2. Effective Citizenship:**

2.1. Learn to participate in nation building by adhering to the principles of sovereignty of the nation, socialism, secularism, democracy and the values that guide a republic.
2.2. Develop and practice gender sensitive attitudes, environmental awareness, empathetic social awareness about various kinds of marginalization and the ability to understand and resist various kinds of discriminations.
2.3. Internalize certain highlights of the nation and region history. Especially of the freedom movement, the renaissance within native societies and the project of modernization of the post-colonial society.

**PO3. Effective Communication:**

3.1. Acquire the ability to speak, write, read and listen clearly in person and through electronic media in both English and in one Modern Indian Language
3.2. Learn to articulate, analyze, synthesize, and evaluate ideas and situations in a well-informed manner.
3.3. Generate hypotheses and articulate assent or dissent by employing both reason and creative thinking.

**PO4. Interdisciplinarity:**

4.1. Perceive knowledge as an organic, comprehensive, interrelated and integrated faculty of the human mind.
4.2. Understand the issues of environmental contexts and sustainable development as a basic interdisciplinary concern of all disciplines.
4.3. Develop aesthetic, social, humanistic and artistic sensibilities for problem solving and evolving a comprehensive perspective.

# Programme Specific Outcomes (PSOs)

Name of the Programme: **BSc MATHEMATICS**

## PROGRAMME SPECIFIC OUTCOMES (PSOs)

**PSO1.**

Understand the basic concepts and tools of Mathematical logic, Set theory, Number theory, Geometry, Calculus, Algebra, Abstract structures, Linear Algebra, Analysis, Laplace transforms, Fourier series, Graph theory, and Optimization and methods of proofs.

**PSO2.**

Model real world problems into Mathematical problems and find solutions and understand the application of Mathematics in other Sciences and Engineering.

# Course Outcomes (COs)

Name of the Programme: **BSc MATHEMATICS**

## COURSE OUTCOMES (COs)

| Sl. No | Name of the Course | Outcomes |
|--------|--------------------|----------|
| 1. | **1B01MAT: SET THEORY, DIFFERENTIAL CALCULUS AND NUMERICAL METHODS** | **CO1:** Understand Relations and Functions.<br>**CO2:** Understand limit of a function, limit laws, continuity, Inverse functions and their derivatives.<br>**CO3:** Understand successive differentiation and Leibnitz theorem.<br>**CO4:** Understand functions of several variables, limit and continuity, partial derivatives, chain rule, homogenous functions and Euler's theorem on homogenous functions.<br>**CO5:** Understand bisection method, Regula-Falsi method and Newton-Raphson method to solve algebraic and transcendental equations. |
| 2. | **2B02MAT: INTEGRAL CALCULUS AND LOGIC** | **CO1:** Understand Hyperbolic functions.<br>**CO2:** Understand Reduction formulae for trigonometric functions and evaluation of definite integrals.<br>**CO3:** Understand Polar coordinates.<br>**CO4:** Understand Double integrals in Cartesian and polar form.<br>**CO5:** Understand triple integrals in rectangular, cylindrical and spherical co-ordinates.<br>**CO6:** Understand Substitution in multiple integrals.<br>**CO7:** Understand Numerical integration: Trapezoidal rule, Simpson's 1/3rd rule.<br>**CO8:** Understand Logic and methods of proofs.<br>**CO9:** Understand Propositional functions, truth set and Negation of quantified statements. |
| 3. | **3B03MAT: ANALYTIC GEOMETRY AND APPLICATIONS OF DERIVATIVES** | **CO1:** Understand cartesian equation of conics, eccentricity, polar equations for a conic, lines, circles.<br>**CO2:** Understand Tangents, Normals and Asymptotes.<br>**CO3:** Understand Curvature, Radius of curvature, Centre of Curvature, Circle of curvature and Evolutes of Cartesian and polar curves.<br>**CO4:** Understand Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem and Taylors Theorem. |

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| | | **CO5:** Understand extreme values of functions, monotonic functions, first derivative test, concavity and curve sketching.<br>**CO6:** Understand Indeterminate forms. |
| 4. | **4B04MAT: NUMBER THEORY AND APPLICATIONS OF INTEGRALS** | **CO1:** Understand Division algorithm, Greatest common Divisor, Euclidean Algorithm, Diophantine equation $ax + by = c$.<br>**CO2:** Understand Primes and their distribution, fundamental theorem of arithmetic, the sieve of Eratosthenes.<br>**CO3:** Understand Basic properties of congruence.<br>**CO4:** Understand Picard's little theorem, Wilson's theorem and Euler's theorem.<br>**CO5:** Understand Substitution and the area between curves, Arc length, Areas and length in polar co-ordinates.<br>**CO6:** Understand Volumes using cross sections, volumes using cylindrical shells and areas of surfaces of revolution. |
| 5. | **5B05MAT: SET THEORY, THEORY OF EQUATIONS AND COMPLEX NUMBERS** | **CO1:** Understand finite and infinite sets, Countable and Uncountable sets, Cantor's theorem.<br>**CO2:** Understand Roots of equations, Relations connecting the roots and coefficients of an equation, Transformation of equations, The cubic equation, Character and position of roots of an equation.<br>**CO3:** Understand Descarte's rule of signs, De Gua's Rule, Limits to the roots of an equation, Rational roots of equations, Newton's method of divisors, Symmetric functions of roots of an equation, Symmetric functions involving only the difference of the roots of $f(x) = 0$, Equations whose roots are symmetric functions of $\alpha$, $\beta$, $\gamma$.<br>**CO4:** Understand Reciprocal equations.<br>**CO5:** Understand Cubic equation, Equation whose roots are the squares of the difference of the roots, Character of the Roots, Cardan's Solution.<br>**CO6:** Understand Roots of complex numbers, General form of De Moivre's theorem, the nth roots of unity, the nth roots of -1, Factors of xn -1 and xn +1, the imaginary cube roots of unity.<br>**CO7:** Understand polar form of complex numbers, powers and roots. |

| 6. | **5B06MAT: REAL ANALYSIS I** | **CO1:** Understand Algebraic Properties, Order Properties and Absolute values of $\mathbb{R}$. Understand the Completeness Property of $\mathbb{R}$ and its applications to derive Archimedean Property and Density theorem.<br>**CO2:** Understand intervals in the real line.<br>**CO3:** Understand Sequences and their Limits, Limit Theorems, Monotone Sequences.<br>**CO4:** Understand Subsequences and the Bolzano-Weierstrass Theorem, The Cauchy Criterion.<br>**CO5:** Understand Infinite Series, Absolute Convergence.<br>**CO6:** Understand Comparison test, Root test, Ratio test, Integral test and Raabe's test for Absolute convergence.<br>**CO7:** Understand Alternating series test, Dirichlet's test and Abel's test for non-absolute convergence.<br>**CO8:** Understand Continuous Functions, composition of continuous functions and continuous functions on intervals. |
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| 7. | **5B07MAT: ABSTRACT ALGEBRA** | **CO1:** Understand definition and elementary properties of Groups, Subgroups and Cyclic groups.<br>**CO2:** Understand Groups of Permutations, orbits, Alternating groups and theorem of Lagrange.<br>**CO3:** Understand group homomorphisms, factor Groups.<br>**CO4:** Understand Fundamental Homomorphism Theorems.<br>**CO5:** Understand definition and properties of rings and fields.<br>**CO6:** Understand Ring homomorphisms and isomorphisms.<br>**CO7:** Understand zero divisors, integral domains, characteristic of a ring and their properties. |
| 8. | **5B08MAT: DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS** | **CO1:** Understand Separable ODEs, Exact ODEs, Linear ODEs, Bernoulli equation and methods to solve these ODEs.<br>**CO2:** Understand the theorem of Existence and Uniqueness of solutions of first and second order ODEs.<br>**CO3:** Understand Homogeneous Linear ODEs of Second Order and solve homogeneous linear ODEs of second order with constant coefficients and Euler-Cauchy equation. |

| | | **CO4:** Understand Laplace Transform and inverse Laplace Transformation. |
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| | | **CO5:** Understand the first and the second shifting theorems and their applications. |
| | | **CO6:** Understand the methods to find Laplace transforms of derivatives and integrals of functions. |
| | | **CO7:** Understand the method of differentiating and integrating Laplace transform. |
| | | **CO8:** Solve ordinary differential equations and integral equations using Laplace transform. |
| 9. | **5B09MAT: VECTOR CALCULUS** | **CO1:** Understand lines and planes in space. |
| | | **CO2:** Understand curves in space, their tangents, normal, curvature, tangential and normal curvature of acceleration. |
| | | **CO3:** Understand Directional derivatives and gradient vectors, tangent planes and differentials. Solve extreme value problems using Lagrange multipliers. |
| | | **CO4:** Understand Partial derivatives with constrained variables and Taylor's formula for two variables. |
| | | **CO5:** Understand Line integrals. Solve for work, circulation and flux using line integrals. |
| | | **CO6:** Understand path independence conservative fields and potential functions. |
| | | **CO7:** Understand Green's theorem and solve problems using Green's theorem. |
| | | **CO8:** Understand Surface area and surface integrals. |
| | | **CO9:** Understand Stoke's theorem and solve problems using Stoke's theorem. |
| | | **CO10:** Understand Divergence theorem and solve problems using Divergence theorem. |
| 10. | **6B10MAT: REAL ANALYSIS II** | **CO1:** Understand Uniform Continuity, Monotone and Inverse Functions. |
| | | **CO2:** Understand Riemann Integral and Riemann-integrable Functions. |
| | | **CO3:** Understand Fundamental Theorem of Calculus |
| | | **CO4:** Understand Improper Integrals. |
| | | **CO5:** Understand Beta and Gamma Functions and their properties. |
| | | **CO6:** Understand Transformations of Gamma Function and Duplication formula. |
| | | **CO7:** Understand Pointwise and Uniform Convergence of sequence of functions and Interchange of Limits. |

| | | **CO8:** Understand Series of Functions. |
| | | **CO9:** Understand the concept of Metric Spaces. |
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| 11. | **6B11MAT: COMPLEX ANALYSIS** | **CO1:** Understand Analytic Function, Cauchy–Riemann Equations. Laplace's Equation.<br>**CO2:** Understand Exponential Function, Trigonometric Functions, Hyperbolic Functions, Logarithmic functions and General Power of complex numbers.<br>**CO3:** Understand line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula and derivatives of analytic functions.<br>**CO4:** Understand convergence of Sequences and Series of complex functions.<br>**CO5:** Understand power series, functions given by power series, Taylor series, Maclaurin's Series and Laurent Series.<br>**CO6:** Understand singularities and zeros of complex functions.<br>**CO7:** Understand residue integration method and integrate real integrals. |
| 12. | **6B12MAT: NUMERICAL METHODS, FOURIER SERIES AND PARTIAL DIFFERENTIAL EQUATIONS** | **CO1:** Understand Interpolation techniques: Interpolation with unevenly spaced points, Langrange interpolation, Newton's divided differences interpolation, Finite difference operators and finite differences, Newton's interpolation formulae and Central difference interpolation.<br>**CO2:** Understand Numerical differentiation using difference formulae.<br>**CO3:** Understand Picard's method, Solution by Taylor series method, Euler method and Runge- Kutta methods.<br>**CO4:** Understand Fourier Series: Arbitrary period, Even and Odd Functions, Half-Range Expansions and Fourier Integrals.<br>**CO5:** Understand Partial Differential equations, Solution by Separating Variables.<br>**CO6:** Understand the use of Fourier Series in solving PDE: D'Alembert's Solution of the Wave Equation. Characteristics and solving Heat Equation by Fourier Series.<br>**CO7:** Understand Laplacian in Polar Coordinates. |

| 13. | **6B13 MAT: LINEAR ALGEBRA** | **CO1:** Understand the concept of Vector spaces, subspaces, linear combinations ad system of equations. |
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| | | **CO2:** Understand the concept of Linear Dependence and Linear Independence, Bases and Dimension, Maximal Linearly Independent Subsets and solves problems. |
| | | **CO3:** Understand the concept of Linear Transformations, Null Spaces, and Ranges, The Matrix Representation of a Linear Transformation. |
| | | **CO4:** Understand Rank of a matrix, Elementary transformations of a matrix, Invariance of rank through elementary transformations, Normal form, Elementary matrices. |
| | | **CO5:** Understand the concept System of linear homogeneous equations Null space and nullity of matrix, Range of a matrix, Systems of linear non homogeneous equations. |
| 14. | **6B14AMAT: GRAPH THEORY** | **CO1:** Understand a graph, subgraph, different types of graphs and their properties. |
| | | **CO2:** Understand and represent graph as matrix. |
| | | **CO3:** Understand a path, cycle, trees, bridges and their properties. |
| | | **CO4:** Understand cut vertices and connectivity of graphs. |
| | | **CO5:** Understand Eulerian graphs, Hamiltonian graphs, The Chinese Postman Problem and the Travelling Salesman Problem. |
| | | **CO6:** Understand planar graphs, Euler's formula, The Platonic bodies and Kuratowski's Theorem |
| | | **CO7:** Model real world problems using the concept of graphs. |
| | | **CO8:** Solve real world problems using the concept of graphs. |
| 15. | **6B14BMAT: OPERATIONS RESEARCH** | **CO1:** Understand convex sets, convex functions, their properties, local and global extrema and quadratic forms. |
| | | **CO2:** Understand LPP, formulate and solve using graphical method. |
| | | **CO3:** Understand General LPP, canonical and standard forms of LPP. |
| | | **CO4:** Understand simplex method and solve LPP. |
| | | **CO5:** Understand basic solution, degenerate solution, basic feasible solution, optimum basic feasible |

| | | solution, fundamental properties of solution and simplex method. |
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| | | **CO6:** Understand primal-dual pair, formulation of dual and duality theorems. |
| | | **CO7:** Understand LP formulation of transportation problem and its solution. |
| | | **CO8:** Understand Mathematical formulation of Assignment problem and Hungarian Assignment method. |
| | | **CO9:** Understand problem of sequencing, Processing 'n' jobs through '2' machines, Processing 'n' jobs through 'k' machines. |
| | | **CO10:** Understand basic terms in Game theory, The Maximin-Minimax Principle, Solution of game with saddle point, Solution of 2x2 game without saddle point, Graphic solution of 2xn and mx2 games and Arithmetic method for nxn Games. |
| 16. | **6B14CMAT: CRYPTOGRAPHY** | **CO1:** Understand Simple Cryptosystems namely, The Shift Cipher, The Substitution Cipher, The Affine Cipher, The Vigenere Cipher, The Hill Cipher, The Permutation Cipher and Stream Ciphers. |
| | | **CO2:** Understand basics of Shannon's Theory, Elementary Probability Theory, Perfect Secrecy, Entropy, Huffman Encodings and Entropy, Properties of Entropy, Spurious Keys and unicity Distance, Product Cryptosystems. |
| | | **CO3:** Understand the Euclidean Algorithm, The Chinese Remainder Theorem. |
| | | **CO4:** Understand Legendre and Jacobi Symbols and quadratic residues. |
| | | **CO5:** Understand the RSA System and Factoring (25 Hours): Introduction to Public-key Cryptography, The RSA Cryptosystem, Implementing RSA, Primality Testing, The Solovay-Strassen Algorithm, The Miller Rabin Algorithm, Square roots modulo n. |
| 17. | **6B14D MAT: FUZZY MATHEMATICS** | **CO1:** Understand Fuzzy Subsets, L-fuzzy Sets, Visual representation of a Fuzzy Subset, Operations on Fuzzy Subsets, Empty Fuzzy Subset 0. |
| | | **CO2:** Understand Universal Fuzzy Subset, Disjoint Fuzzy Subsets, Disjunctive Sum. |
| | | **CO3:** Understand α Level Set, Properties of Fuzzy Subsets of a Set, Algebraic Product and Sum of Two |

| | | Fuzzy Subsets, Properties Satisfied by Addition and Product. **CO4:** Understand Cartesian Product of Fuzzy Subsets. **CO5:** Understand Fuzzy Relations, Binary Fuzzy Relations, Binary Relations on a Single Set, Fuzzy Equivalence Relations. **CO6:** Understand Fuzzy Subgroup, Fuzzy Sub groupoids. **CO7:** Understand the Lattice of Fuzzy Subgroups, Fuzzy Subgroup, Fuzzy Subrings. |
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| colspan="3" | **DISCIPLINE SPECIFIC ELECTIVE COURSE** |
| 18. | **6B14EMAT PROGRAMMING IN PYTHON** | **CO1:** Understand the basics of Python Variables, Indentation in Python, Input, Output and Import Functions Operators. **CO2:** Understand Python programming for numbers, Dictionaries and Mathematical functions. **CO3:** Understand Flow Control, if, if..else, if ,.else, Loops – for loop, Range Function, while, Section 3.3 Nested Loop, Break and Continue Statements in Python. **CO4:** Understand Data visualization – The Matplot lib Module, plotting mathematical functions, Famous Curves, 2D plot using colors, Mesh grids, 3D Plots using Python. **CO5:** Understand Python programming for Solving equations using Newton-Raphson's Method, Bisection Method, Method of false position, Trapezoidal rule of numerical integration, Simpson's three eighth rule of numerical integration, Euler's modified methos to solve first order differential equation, Runge-Kutta Method of order 4, Lagrange's method of interpolation. |
| **COMPLEMENTARY ELECTIVE COURSES** |
| 19. | **1C01MAT-PH MATHEMATICS FOR PHYSICS I** | **CO1:** Understand the concept of Differentiation and successive differentiation. **CO2:** Understand Fundamental theorem – Rolle's theorem, Lagrange's mean-value theorem, Cauchy's mean-value theorem. **CO3:** Understand the Taylor's theorem, expansions of functions – Maclaurin's series, expansion by use of known series. |

| | | CO4: Understand the Matrices and System of Equations, Linear Transformations. |
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| | | CO5: Understand Rank of a matrix, elementary transformations, normal form of a matrix, inverse of a matrix, solution of linear system of equations. |
| | | CO6: Understand Linear transformations, orthogonal transformation, vectors – linear dependence. |
| | | CO7: Understand Derivative of arc, curvature, Polar coordinates, Cylindrical and Spherical co-ordinates. |
| 20. | **2C02MAT-PH MATHEMATICS FOR PHYSICS II** | CO1: Understand partial derivatives, homogeneous functions, Euler's theorem, total derivative, differentiation of implicit functions, change of variables. |
| | | CO2: Understand Integration and Integration by Successive Reduction, Integration of Trigonometric Functions. |
| | | CO3: Comprehend Applications of Integration. |
| | | CO4: Comprehend Eigen values, Eigen vectors, properties of Eigen values. |
| | | CO5: Understand Cayley-Hamilton theorem, Diagonal form, similarity of matrices, powers of a matrix, canonical form, nature of a quadratic form. |
| 21. | **3C03MAT-PH MATHEMATICS FOR PHYSICS III** | CO1: Understand the concept of Multiple Integrals and solves problems. |
| | | CO2: Understand Vector Differentiation. |
| | | CO3: Understand Laplace Transforms and its Applications. |
| | | CO4: Understand Fourier Series and Half range expansions. |
| 22. | **4C04MAT-PH MATHEMATICS FOR PHYSICS IV** | CO1: Understand Wave Equation, Solution by Separating Variables, D-Alembert's solution of the wave equation. |
| | | CO2: Understand Heat Equation and Solution by Fourier Series. |
| | | CO3: Understand Line integrals, path independence, conservative fields and potential functions, Green's theorem in the plane. |
| | | CO4: Understand Surface area, surface integrals, Stoke's theorem, Divergence theorem. |
| | | CO5: Understand Numerical Integration, Trapezoidal Rule, Simpson's 1/3-Rule. |

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| | | **CO6:** Understand Numerical Solutions of Ordinary Differential Equations by Taylor's series, Euler's method, Modified Euler's method, Runge-Kutta methods. |
| 23. | **1C01MAT-CH MATHEMATICS FOR CHEMISTRY I** | **CO1:** Understand Successive differentiation and Leibnitz's theorem for the nth derivative of the product of two functions.<br>**CO2:** Understand Fundamental theorem – Rolle's theorem, Lagrange's mean-value theorem and Cauchy's mean value theorem.<br>**CO3:** Understand Taylor's theorem, expansions of functions – Maclaurin's series, expansion by use of known series and Taylor's series.<br>**CO4:** Understand the method of finding limits of Indeterminate forms.<br>**CO5:** Understand Polar, Cylindrical and Spherical co-ordinates.<br>**CO6:** Understand Rank of a matrix, elementary transformation of a matrix, equivalent matrices, elementary matrices, Gauss-Jordan method of finding the inverse, normal form of a matrix and partition method of finding the inverse.<br>**CO7:** Understand solution of linear system of equations –method of determinants – Cramer's rule, matrix inversion method, consistency of linear system of equations, Rouche's theorem, procedure to test the consistency of a system of equations in n unknowns, system of linear homogeneous equations.<br>**CO8:** Understand Linear transformations, orthogonal transformation and linear dependence of vectors.<br>**CO9:** Understand methods of curve fitting, graphical method, laws reducible to the linear law, principles of least squares, method of least squares and apply the principle of least squares to fit the straight-line $y = a + bx$, to fit the parabola $y = a + bx + cx^2$, to fit $y = ax^b$, $y = ae^{bx}$ and $xy^n = b$. |
| 24. | **2C02MAT-CH MATHEMATICS FOR CHEMISTRY I** | **CO1:** Understand Functions of two or more variables, limits and continuity.<br>**CO2:** Understand partial derivatives, homogeneous functions, Euler's theorem on homogeneous functions, total derivative, differentiation of implicit functions and change of variables. |

| | | CO3: Understand Reduction formulae for trigonometric functions and evaluation of definite integrals.<br>CO4: Understand Substitutions and the area between curves, arc length, areas and length in polar coordinates.<br>CO5: Understand Double and Iterated Integrals over rectangles, double integrals over general regions, area by double integration, double integrals in polar form and triple integrals in rectangular co-ordinates.<br>CO6: Understand Eigen values, Eigen vectors, properties of Eigen values, Cayley-Hamilton theorem, reduction to diagonal form, similarity of matrices, powers of a matrix, reduction of quadratic form to canonical form and nature of a quadratic form. |
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| 25. | **3C03MAT-CH MATHEMATICS FOR CHEMISTRY III** | CO1: Understand Ordinary differential equations, Geometrical meaning of $y' = f(x, y)$ and Direction Fields.<br>CO2: Understand Methods of solving Differential Equations: Separable ODEs, Exact ODEs, Integrating Factors, Linear ODEs and Bernoulli Equation.<br>CO3: Understand Orthogonal Trajectories, Existence and Uniqueness of Solutions.<br>CO4: Understand Second order ODEs, Homogeneous Linear ODEs of second order, Homogeneous Linear ODEs with constant coefficients, Differential Operators, Euler-Cauchy Equation, Existence and Uniqueness of Solutions – Wronskian, Nonhomogeneous ODEs and Solution by variation of Parameters.<br>CO5: Understand Laplace Transform, Linearity, first shifting theorem, Transforms of Derivatives and Integrals, ODEs, Unit step Function, second shifting theorem, Convolution, Integral Equations, Differentiation and integration of Transforms and to solve special linear ODE's with variable coefficients and Systems of ODEs.<br>CO6: Understand Fourier series, arbitrary period, Even and Odd functions, Half-range Expansions. |
| 26. | **4C04MAT-CH MATHEMATICS FOR CHEMISTRY IV** | CO1: Understand Partial Differential Equations, Modeling, Vibrating String, Wave Equation. |

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| | | **CO2:** Solve PDE by Separating Variables, by use of Fourier Series, D-Alembert's solution of the wave equation and Heat Equation.<br>**CO3:** Understand Numerical Integration, Trapezoidal Rule, Simpson's 1/3-Rule.<br>**CO4:** Understand Numerical methods to find Solutions of Ordinary Differential Equations: Solution by Taylor's series, Euler's method, Modified Euler's method, Runge-Kutta methods.<br>**CO5:** Understand volumes of solid using cross sections and areas of surfaces of revolution. |
| | **GENERIC ELECTIVE COURSE** | |
| 27. | **5D02MAT QUANTITATIVE ARITHMETIC AND REASONING** | **CO1:** Understand average, Problems on ages, Profit and loss and solves problems.<br>**CO2:** Understand Profit and loss, Ratio and proportion, Chain rule.<br>**CO3:** Comprehend Time and work, Time and distance and solves problems.<br>**CO4:** Comprehend Problems on trains, Boats and streams, Calendar, Clocks. |
| 28. | **5D05MAT BUSINESS MATHEMATICS** | **CO1:** Understand the concept of Limit and continuity, methods of finding limits definition, Differentiation-rules of differentiation, Parametric function logarithmic differentiation.<br>**CO2:** Understand the Successive differentiation, Local maximum and local minimum and solves problems.<br>**CO3:** Understand the Rules of integration, Some standard results, Consumer's surplus, Producer's surplus, Consumer's surplus.<br>**CO4:** Understand rate of interest, Continuous compounding, Compound interest, Present valve, interest and discount, Rate of discount, Equation of value, Depreciation and solves problems. |
| | **STATISTICS** | |
| 29. | **OPEN COURSE 5D01STA SAMPLING TECHNIQUES** | **CO1:** Understand different types of data.<br>**CO2:** Understand the concept the census and sampling.<br>**CO3:** Apply different sampling methods.<br>**CO4:** Familiarize with the various statistical organizations. |

| | | COMPLEMENTARY COURSES FOR BSc MATHEMATICS |
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| 30. | **1C01STA BASIC STATISTICS** | **CO1:** Understand the different types of data.<br>**CO2:** Compute various measures of central tendency, measures of variation.<br>**CO3:** Analyze the relationship between two variables.<br>**CO4:** Acquire knowledge in time series data and compute various index numbers. |
| 31. | **2C02STA PROBABILITY THEORY AND RANDOM VARIABLES** | **CO1:** Evaluate the probability of events.<br>**CO2:** Understand the concept of random variables with examples in real life.<br>**CO3:** Calculate the probability distribution of discrete and continuous random variables.<br>**CO4:** Understand the change of variable technique. |
| 32. | **3C03STA PROBABILITY DISTRIBUTIONS** | **CO1:** Compute mathematical expectation of a random variable.<br>**CO2:** Familiarize with different discrete probability distribution associated with real life situations.<br>**CO3:** Understand the characteristics of different continuous distributions.<br>**CO4:** Identify the appropriate probability model that can be used. |
| 33. | **4C04STA STATISTICAL INFERENCE** | **CO1:** Understand the uses of Chebychev's Inequality and Central Limit Theorem.<br>**CO2:** Apply various method of estimation.<br>**CO3:** Understand the concept of testing statistical hypotheses and its importance in real life situation.<br>**CO4:** Apply ANOVA. |