DEPARTMENT OF MATHEMATICS

PROGRAMME: B.Sc. MATHEMATICS

PROGRAMME OUTCOMES (PO)

PO 1. 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.

PO 2. 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's and region's history. Especially of the freedom movement, the renaissance within native societies and the project of modernization of the post-colonial society**.**

PO 3. 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, analyses, 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.

PO 4. Interdisciplinary

4.1. Perceive knowledge as an organic, comprehensive, interrelated and integrated faculty of the human mind.

4 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 OF B.SC. MATHEMATICS PROGRAMME

PSO 1: 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.

PSO 2: Model real world problems into Mathematical problems and find solutions and understand the application of Mathematics in other Sciences and Engineering

COURSE OUTCOME

SEI	COURSE CODE	Title of the Course	COURSE OUTCOME
1	1B01 MAT	Set Theory, Differential Calculus and Numerical Methods	CO1 Understand Relations and Functions CO2 Understand limit of a function, limit laws, continuity, Inverse functions and their derivatives CO3 Understand successive differentiation and Leibnitz theorem CO4 Understand functions of several variables, limit and continuity, partial derivatives, chain rule, homogenous functions and Euler's theorem on homogenous functions CO5 Understand bisection method, Regula-falsi method and Newton Raphson method to solve algebraic and transcendental equations
2	2B02 MAT	Integral Calculus and Logic	CO1 Understand Hyperbolic functions CO2 Understand Reduction formulae for trigonometric functions and evaluation of definite integrals $\int_o^{\frac{\pi}{2}} \sin^m dx$, $\int_o^{\frac{\pi}{2}} cos^n x\, dx$ and $\int_o^{\frac{\pi}{2}} \sin^n x cos^m x\, dx$ CO3 Understand Polar coordinates CO4 Understand Double integrals in Cartesian and polar form. CO5 Understand triple integrals in rectangular, cylindrical and spherical co-ordinates CO6 Understand Substitution in multiple integrals CO7 Understand Numerical integration: Trapezoidal rule, Simpson's 1/3rd rule CO8 Understand Logic and methods of proofs CO9 Understand Propositional functions, truth set and Negation of quantified statements
3	3B03 MAT	Analytic Geometry and Applications of derivatives	CO1 Understand Cartesian equation of conics, eccentricity, polar equations for a conic, lines, circles CO2 Understand Tangents, Normal and Asymptotes CO3 Understand Curvature, Radius of curvature ,Centre of Curvature, Circle of curvature and Evolutes of Cartesian and polar curves, CO 4 Understand Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem and Taylors Theorem CO5 Understand extreme values of functions, monotonic functions, first derivative test , concavity and curve sketching CO6 Understand Indeterminate forms
5	5B05 MAT	Set theory, Theory of Equations and Complex numbers	CO1 Understand finite and infinite sets, Countable and Uncountable sets,Cantor's theorem. 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.

			CO3	Understand Descartes's rule of signs, De Guam'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 α,β, γ.
			CO4	Understand Reciprocal equations.
			CO5	Understand Cubic equation, Equation whose roots are the squares of the difference of the roots, Character of the Roots, Cardin's Solution
			CO6	Understand Roots of complex numbers, General form of De Moiré'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.
			CO7	Understand polar form of complex numbers, powers and roots.
5	5B06 MAT	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.
			CO2	Understand intervals in the real line.
			CO3	Understand Sequences and their Limits, Limit Theorems, Monotone Sequences.
			CO4	Understand Subsequences and the Bolzano-Weierstrass Theorem, The Cauchy Criterion.
			CO5	Understand Infinite Series, Absolute Convergence.
			CO6	Understand Comparison test, Root test, Ratio test, Integral test and Raabe's test for Absolute convergence.
			CO7	Understand Alternating series test, Dirichlet's test and Abel's test for Non Absolute convergence.
			CO8	Understand Continuous Functions, composition of continuous functions and continuous functions on intervals.
	5B08 MAT	Differential Equations and Laplace Transform	CO1	Understand Separable ODEs, Exact ODEs, Linear ODEs, Bernoulli equation and methods to solve these ODEs
			CO2	Understand the theorem of Existence and Uniqueness of solutions of first and second order ODEs
			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 Nonhomogeneous ODEs and solve by variation of parameters
			CO5	Understand Laplace Transform and inverse Laplace Transformation
			CO6	Understand The first and The second shifting theorems and their applications
			CO7	Understand the methods to find Laplace transforms of derivatives and integrals of functions
			CO8	Understand the method of differentiating and integrating Laplace transform
			CO9	Solve ordinary differential equations and integral equations using Laplace transform
	5B09	Vector Calculus	CO1	Understand lines and planes in space
			CO2	Understand curves in space, their tangents, normal, curvature,

	MAT			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
	5D01MAT Open Course	Business Mathematics	CO1	Understand the concept of Limit and continuity, methods of finding limits definition, Differentiation- rules of differentiation, Parametric function logarithmic differentiation.
			CO2	Understand the Successive differentiation, Local maximum and local minimum and solves problems
			CO3	Understand the Rules of integration, Some standard results, Consumer's surplus, Producer's surplus, Consumer's surplus
			CO4	Understand rate of interest, Continuous compounding, Compound interest, Present valve, interest and discount, Rate of discount, Equation of value, Depreciation and solves problems
6	6B10 MAT	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 Point wise and Uniform Convergence of sequence of functions and Interchange of Limits
			CO8	Understand Series of Functions
			CO9	Understand the concept of Metric Spaces
	6B11 MAT	Complex Analysis	CO1	Understand Analytic Function, Cauchy–Riemann Equations. Laplace's Equation.
			CO2	Understand Exponential Function, Trigonometric Functions, Hyperbolic Functions, Logarithmic functions and General Power of complex numbers
			CO3	Understand line integral in the complex plane ,Cauchy's integral theorem , Cauchy's integral formula and derivatives of analytic functions
			CO4	Understand convergence of Sequences and Series of complex functions
			CO5	Understand power series, functions given by powerseries, Taylor series, Maclaurin's Series and Laurent Series
			CO6	Understand singularities and zeros of complex functions
			CO7	Understand residue integration method and integrate real

				integrals
	6B12 MAT	Numerical Methods, Fourier series and Partial Differential Equations	CO1	Understand Interpolation techniques: Interpolation with unevenly space points, Langrange interpolation, Newton's divided differences interpolation, Finite difference operators and finite differences, Newton interpolation formulae and Central difference interpolation.
			CO2	Understand Numerical differentiation using difference formulae
			CO3	Understand Picard's method, Solution by Taylor series method, Euler method and Runge- Kutta methods.
			CO4	Understand Fourier Series: Arbitrary period, Even and Odd Functions, Half-Range Expansions and Fourier Integrals.
			CO5	Understand Partial Differential eqations, Solution by Separating Variab
			CO6	Understand the use of Fourier Series in solving PDE: D'Alembert's Solution of the Wave Equation. Characteristics and solving Heat Equa by Fourier Series.
			CO7	Understand Laplacian in Polar Coordinates
	6B13 MAT	Linear Algebra	CO1	Understand the concept of Vector spaces, subspaces, linear combinations ad system of equations.
			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 oflinear non homogeneous equations.
			CO6	Understand Eigen values, Eigen vectors, Properties of Eigen values, Cayley-Hamilton theorem
	6B14B MAT	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
			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.
	MAT	Project		

Complementary Courses- Mathematics for Polymer Chemistry			
1	1C01 MAT-CH	Mathematics for Chemistry I	**CO1:** Understand Hyperbolic Functions, Calculation of the n th derivative – some standard results,determination of n th derivative of rational functions -Leibniz's theorem, Maclaurin's Theorem and Taylor's Theorem **CO2** Understand Rolle's theorem, Lagrange's mean value theorem, Meaning of sign of derivative, Cauchy's mean value theorem, higher derivatives, Indeterminate forms, **CO3** Understand Partial Differentiation,continuity of a function of two variables limit of a function of two variables, homogeneous functions , Curvature, Radius of curvature (Cartesian Equations), Centre of Curvature, Evolutes and Involutes **CO4:** Understand Polar coordinates in two dimensional ,Cylindrical and Spherical Coordinates.
2	2C02MA T-CH	Mathematics for Chemistry II	**CO1:** Understand Integration of Trigonometric Functions Areas of Plane Regions, lengths of plane curves **CO2** Understand Volumes and Surfaces of Revolution using integration Multiple Integrals, Double integral, Applications of Double Integration, Triple integrals **CO3** Understand Applications of Matrix Multiplication, Linear Systems of Equations, Gauss Elimination, Row equivalent Systems, Linear Independence, Rank of a Matrix, Vector Space, Solutions of Linear Systems ,Cramer's Rule, Inverse of a Matrix: GaussJordan Elimination **CO4:** Understand Matrix Eigen Value Problems, Cayley-Hamilton Theorem
3	3C03 MAT-CH	Mathematics for Chemistry III	**CO1:** Understand First Order Ordinary Differential Equations Basic concepts, Separable ODEs, Exact ODEs, Integrating Factors, Linear ODEs, Bernoulli Equation **CO2** Understand Second Order Ordinary Differential Equations, Homogeneous Linear ODEs of second order, Homogeneous Linear ODEs with constant coefficients, Euler-Cauchy Equation, Wronskian, Nonhomogeneous ODEs, Solution by variation of Parameters **CO3** Understand Laplace Transform, Inverse Transform, Linearity, s-Shifting, Transforms of Derivatives and Integrals, t- Shifting, Convolution, Integral Equations, Differentiation and integration of Transforms. **CO4:** Understand Fourier series, Functions of any period p = 2L,Half-range Expansions Partial differential Equations,Wave Equation, Solution by Separating Variables, D-Alembert's solution of the wave equation, Heat Equation, Solution by Fourier Series.
4	4C04 MAT-CH	Mathematics for Chemistry I V	**CO1:** Understand Vector and scalar functions and Fields, Derivatives, Gradient of a scalar field;Divergence of a vector field, Curl of a Vector Field. **CO2** Understand Line Integrals, Green's Theorem in the Plane ,Surface Integrals, Triple Integrals, Divergence theorem of Gauss, Stoke's theorem **CO3** Understand Solution of Algebraic and Transcendental Equation: Bisection Method, Newton-Raphson Method ,Finite Differences,Interpolation, Divided differences and their properties, Numerical Differentiation and Integration ,Trapezoidal Rule, Simpson's 1/3- Rule **CO4:** Understand Numerical Solutions ofODE: Solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's method, Runge-Kutta method.
Complementary Courses			

Mathematics for Computer Science			
1	1C01MAT-CS	Mathematics for Computer Science I	**CO1:** Understand Hyperbolic Functions, Calculation of the n th derivative – some standard results,determination of n th derivative of rational functions -Leibniz's theorem, Maclaurin's Theorem and Taylor's Theorem **CO2** Understand Rolle's theorem, Lagrange's mean value theorem, Meaning of sign of derivative, Cauchy's mean value theorem, higher derivatives, Indeterminate forms, **CO3** Understand Partial Differentiation,continuity of a function of two variables limit of a function of two variables, homogeneous functions , Curvature, Radius of curvature (Cartesian Equations), Centre of Curvature, Evolutes and Involutes **CO4:** Understand Polar coordinates in two dimensional ,Cylindrical and Spherical Coordinates
2	2C02 MAT-CS	Mathematics for Computer Science II	**CO1:** Understand Integration of Trigonometric Functions Areas of Plane Regions, lengths of plane curves **CO2** Understand Volumes and Surfaces of Revolution using integration Multiple Integrals, Double integral, Applications of Double Integration, Triple integrals **CO3** Understand Applications of Matrix Multiplication, Linear Systems of Equations, Gauss Elimination, Row equivalent Systems, Linear Independence, Rank of a Matrix, Vector Space, Solutions of Linear Systems ,Cramer's Rule, Inverse of a Matrix: GaussJordan Elimination **CO4:** Understand Matrix Eigen Value Problems, Cayley-Hamilton Theorem
3	3C03 MAT-CS	Mathematics for Computer Science III	**CO1:** Understand First Order Ordinary Differential Equations Basic concepts, Separable ODEs, Exact ODEs, Integrating Factors, Linear ODEs, Bernoulli Equation **CO2** Understand Second Order Ordinary Differential Equations, Homogeneous Linear ODEs of second order, Homogeneous Linear ODEs with constant coefficients, Euler-Cauchy Equation, Wronskian, Nonhomogeneous ODEs, Solution by variation of Parameters **CO3** Understand Laplace Transform, Inverse Transform, Linearity, s-Shifting, Transforms of Derivatives and Integrals, t- Shifting, Convolution, Integral Equations, Differentiation and integration of Transforms. **CO4:** Understand Fourier series, Functions of any period p = 2L,Half-range Expansions Partial differential Equations,Wave Equation, Solution by Separating Variables, Alembert's solution of the wave equation, Heat Equation, Solution by Fourier Series.
4	4C04 MAT-CS	Mathematics for Computer Science IV	**CO1:** Understand Vector and scalar functions and Fields, Derivatives, Gradient of a scalar field;Divergence of a vector field, Curl of a Vector Field. **CO2** Understand Line Integrals, Green's Theorem in the Plane ,Surface Integrals, Triple Integrals, Divergence theorem of Gauss, Stoke's theorem **CO3** Understand Solution of Algebraic and Transcendental Equation: Bisection Method, Newton-Raphson Method ,Finite Differences,Interpolation, Divided differences and their properties, Numerical Differentiation and Integration ,Trapezoidal Rule, Simpson's 1/3- Rule **CO4:** Understand Numerical Solutions ofODE: Solution by Taylor's series, Pica method of successive approximations, Euler's method, Modified Euler's method, Runge-Kutta method.