DEPARTMENT OF MATHEMATICS

PROGRAMME : B Sc Mathematics

Programme Specific Outcomes (PSOs)

PSO	PSO Statement Upon completion of the B.Sc. Mathematics Degree Programme, the under graduates will be able to:
PSO1	Understand the concepts of Mathematical logic methods of proofs, sets, relations and partial ordering.
PSO2	Understand the basic concepts of Theory of equations, Trigonometry and Differential Calculus
PSO3	Understand the advanced concepts of Mathematical Analysis, Differential Equations, Algebra, Graph Theory and Metric Spaces, Complex Analysis, Numerical Analysis and Linear Algebra
PSO4	Understand the basic knowledge about environment and to inform the students about the social norms that provide unity with environmental characteristics and create positive attitude about the environment

Core course

Course Outcomes (COs)

Course	Details
Year/ Semester	I/I
Type	Core Course (Theory)
Code	MM1CRT01
Title	Foundation of Mathematics
Credits	3
Hrs/ week	4
Total Hrs	72

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand mathematical statements
CO2	Analyse mathematical statements using truth tables
CO3	Understand the idea behind construction of proofs
CO4	Understand sets and functions
CO5	Analyse different properties of relations
CO6	Describe different methods to find roots of an equation
CO7	Understand the appropriate methods to find the solution of a cubic equation

Course	Details
Year/ Semester	I/2
Type	Core Course (Theory)
Code	MM2CRT01
Title	Analytic Geometry, Trigonometry & Differential Calculus
Credits	3
Hrs/ week	4
Total Hrs	72

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Find equation of tangents and normal of a conic
CO2	Evaluate chords of a given conic
CO3	Understand polar coordinates
CO4	Describe equation of lines, circles and conics in polar coordinates
CO5	Understand the idea of circular and hyperbolic functions
CO6	Find the real and imaginary parts of functions of complex variables
CO7	Find the summation of some infinite series
CO8	Evaluate successive differentiation
CO9	Understand indeterminate forms

Core Course Outcomes (COs)

Course	**Details**
Year / Semester	2/3
Type	Core Course
Code	MM3CRT01
Title	Calculus
Credits	4
Hrs/Week	5 Hrs
Total Hours	90 Hrs

CO No.	**CO Statement**
CO1	Understand the expansion of functions using Maclaurin's theorem and Taylor's theorem.
CO2	Understand concavity, points of inflexion, curvature, evolutes, length of arc as a function derivatives of arc
CO3	Describe radius of curvature, evolutes and involutes, properties of evolutes, asymptotes and envelopes.
CO4	Understand partial derivatives and Lagrange multipliers.
CO5	Determine volume of surface using different methods.
CO6	Determine arc length and areas of surface of revolution
CO7	Discuss examples to find area using double integration
CO8	Determine the volume of a surface using triple integrals in cylindrical and spherical coordinates.

Course	Details
Year / Semester	2/4
Type	Core Course
Code	MM4CRT01
Title	Vector Calculus, Theory of Numbers and Laplace Transform
Credits	4
Hrs/Week	5 Hrs
Total Hours	90 Hrs

CO No.	CO Statement
CO1	Understand vector functions.
CO2	Describe line integrals, vector fields and line integrals, path independence.
CO3	Understand Green's theorem in the plane, Stokes' theorem, Divergence theorem.
CO4	Discuss examples to find the arc length and curvature.
CO5	Discuss examples to verify Green's theorem, Stokes' theorem and Divergence theorem.
CO6	Describe properties of congruence, Fermat's theorem, Wilson's theorem and Euler-Phi function
CO7	Understand Laplace transform, linearity and existence of Laplace transform, convolution and integral equations.
CO8	Discuss examples of initial value problem.

CORE COURSES

Course Outcomes (COs)

Course	Details
Year/ Semester	III/V
Type	Core Course (Theory)
Code	MM5CRT01
Title	Mathematical Analysis
Credits	4
Hrs/ week	6
Total Hrs	108

CORE COURSES

Course Outcomes (COs)

CO No.	CO Statement
CO1	Define Real number system, finite and infinite set, function, limit of a function, absolute value, Intervals and real line
CO2	Understand the algebraic, completeness and order properties of real number, supremum and infimum of a set
CO3	Define sequence and their limits, subsequence, monotone sequence, series and their examples
CO4	Define convergence and divergence of a sequence and test whether a given sequence is convergent or not.
CO5	Explain theorems based on Sequences and series
CO6	Discuss about absolute convergence and non absolute convergence of a series.
CO7	Understand the concept of limit of functions, its theorems and extension
CO8	Compute the limit of a given function at a point

Course	Details
Year/ Semester	III/V
Type	Core Course (Theory)
Code	MM5CRT02
Title	Differential Equations
Credits	4
Hrs/ week	6
Total Hrs	108

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the nature of differential equations
CO2	Solve and apply the solution of first second and higher order differential equations
CO3	Understand the idea behind the orthogonal trajectory and families of curves
CO4	Understand the concepts of solution of a differential equation and the power series solution
CO5	Apply the power series method to solve the differential equations
CO6	Develop the ability to apply the solution of the differential equation in theoretical and practical problems
CO7	Understand the concepts of partial differential equations and its solutions

CORE COURSES

Course Outcomes (COs)

Course	Details
Year/ Semester	III/V
Type	Core Course (Theory)
Code	MM5CRT03
Title	Abstract Algebra
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement
CO1	Recall the concepts of sets, binary operations, number system and permutation
CO2	Understand the basic concepts about Group, Ring and field and the basic properties of these algebraic structures
CO3	Construct Group table for finite groups.
CO4	Discuss various examples to thorough the concepts
CO5	Explain Group Homomorphism by using relationship between groups
CO6	Understand the basic information about Cyclic group, Alternate group, Permutation Group, Direct product of groups and Cosets
CO7	Extend the concept of group homomorphism to ring homomorphism
CO8	Determine whether a given set with associated operations is a group, ring or field by checking its properties.

CORE COURSES

Course Outcomes (COs)

Course	Details
Year/ Semester	3/5
Type	Core Course (Theory)
Code	MM5CRT04
Title	Environmental Mathematics and Human Rights
Credits	4
Hrs/ week	4
Total Hrs	72

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the multidisciplinary nature of environmental studies
CO2	Understand the role of individual in conservation of natural resources
CO3	Describe natural resources such as forest resources, water resources, mineral resources, energy resources, land resources, etc.
CO4	Understand the concept of ecosystem
CO5	Define pollution , its causes, effects and measures
CO6	Explain the importance of Fibonacci numbers in nature
CO7	Explain Golden ratio
CO8	Describe human rights

Open Course

Course Outcomes (COs)

Course	Details
Year/ Semester	3/5
Type	Open Course (Theory)
Code	MM5OPT02
Title	Applicable Mathematics
Credits	4
Hrs/ week	4
Total Hrs	72

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the concepts in simplification
CO2	Analyse problems in ration and proportion, percentage, profit and loss
CO3	Find heights and distance using trigonometry
CO4	Evaluate simple interest and compound interest.
CO5	Analyse problems in time and work, work and wages and time and distance
CO6	Understand exponential series and logarithmic series
CO7	Find area and perimeter of polygons
CO8	Understand simple factorisation of quadratic and cubic polynomials
CO9	Evaluate basic problems in differentiation

CORE COURSES

Course Outcomes (COs)

Course	Details
Year/ Semester	3/6
Type	Core Course (Theory)
Code	MM6CRT01
Title	Real Analysis
Credits	4
Hrs/ week	5
Total Hrs	108

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Identify the continuous functions as a very special class of functions that arises in real analysis. Understand the concept of continuity and establish the fundamental properties of continuous functions
CO2	Distinguish the concepts continuity and uniform continuity. Also explain the sufficient condition for uniform continuity. Study on monotone functions that are not necessarily continuous. Illustrations are provided
CO3	Concentrate on mathematical aspects of derivative and it's applications in geometry, physics and economics
CO4	Develop the knowledge of Riemann integrability of real valued functions and it's applications
CO5	Explore the connections between the notions of the derivative and the integral. Establish the necessary and sufficient condition for a function to be Riemann integrable and mention some of its applications
CO6	Understand the concept of sequences of functions and their convergences. Detailed study on uniform convergence and apply this concept to define and derive the properties of exponential and logarithmic functions

Course Outcomes (COs)

Course	Details
Year/ Semester	III/VI
Type	Core Course (Theory)
Code	MM6CRT02
Title	Graph Theory and Metric Space
Credits	4
Hrs/ week	6
Total Hrs	108

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Define Graph, types of graphs, subgraphs, vertex degree, paths and cycles
CO2	Construct adjacency matrix and incidence matrix of each graphs
CO3	Understand the concepts of trees and its properties
CO4	Understand the concepts of bridge, spanning tree, cut vertex and connectivity
CO5	Explain Euler's tours, Hamiltonian cycle and apply these concepts in Chinese postman problem and travelling salesman problem.
CO6	Define metric space, open set, closed set, cantor set.
CO7	Discuss the examples of metric space, open set and closed set.
CO8	Explain the concepts of convergence, completeness and continuous mapping in metric spaces

Core Course

Course Outcomes (COs)

Course	Details
Year/ Semester	I/2
Type	Core Course (Theory)
Code	MM6CRT03
Title	Complex Analysis
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand functions of complex variables
CO2	Analyse different concepts of functions of a complex variable
CO3	Evaluate integrals of a function of complex variable
CO4	Understand some important theorems in complex analysis
CO5	Understand the convergence of sequence and series
CO6	Evaluate problems using Taylor's theorem and Laurent's series
CO7	Describe singular points and residues of a complex function
CO8	Apply residue in evaluating integrals

CORE COURSES

Course Outcomes (COs)

Course	Details
Year/ Semester	3/5
Type	Core Course (Theory)
Code	MM6CRT04
Title	Linear Algebra
Credits	4
Hrs/ week	6
Total Hrs	108

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO2	Understand the concept elementary matrices, the process of Gaussian elimination
CO3	Understand and analyze the definitions of Linear combinations of rows (columns), linear independence of columns, and row equivalent matrices
CO4	Define and compute Hermite or reduced row-echelon matrices, rank of a matrix, column rank, normal form
CO6	Understand the definitions vector spaces, subspaces, linear combination of vectors, spanning set, linear independence and basis
CO7	Understand the notions of Linear transformations, Kernel and range, Rank and Nullity, Linear isomorphism with examples and properties
CO9	Develop the knowledge of Characteristic polynomial, Characteristic equation, Algebraic multiplicities, Eigen space, Geometric multiplicities, Eigenvector, diagonalisation and Tri-diagonal matrix
CO10	Solve the problems involving Characteristic equation, Algebraic multiplicities, Eigen space, Geometric multiplicities, Eigenvectors and eigen spaces

CHOICE BASED CORE COURSES

Course Outcomes (COs)

Course	Details
Year/ Semester	3/6
Type	Core Course (Theory)- Choice Based Course
Code	MM6CBT03
Title	NUMERICAL ANALYSIS
Credits	3
Hrs/ week	4
Total Hrs	72

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Define algebraic and transcendental equation
CO2	Solve algebraic equations using different methods
CO3	Calculate errors in polynomial interpolation
CO4	Understand Fourier Series and transform
CO5	Define DFT and IDFT
CO6	Explain numerical differentiation
CO7	Find errors in Numerical Differentiation
CO8	Understand various methods of numerical integration

COMPLEMENTARY COURSE

Course	Details
Year / Semester	1/1
Type	Complementary Course
Code	MM1CMT01
Title	Partial Differentiation, Matrices, Trigonometry And Numerical Analysis
Credits	3
Hrs/Week	4 Hrs
Total Hours	72 Hrs

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the expansions of sin $n\theta$, cos $n\theta$, tan $n\theta$, $\sin^n\theta$, $\cos^n\theta$.
CO2	Understand circular and hyperbolic functions and summation of infinite series based on C+iS method.
CO3	Understand rank of a matrix, elementary transformations of a matrix, system of linear homogeneous equations, system of non-linear homogeneous equations, Cayley Hamilton theorem.
CO4	Determine the rank of a given matrix by reducing it to normal form.
CO5	Determine the characteristic roots and characteristic vectors of a square matrix.
CO6	Write the given system of linear equations in matrix form.
CO7	Solve the given system of linear equations using elementary transformations.
CO8	Determine an approximate root of an equation using different methods.

Course	Details
Year / Semester	1/2
Type	Complementary Course
Code	MM2CMT01
Title	Integral Calculus and Differential Equations
Credits	3
Hrs/Week	4 Hrs
Total Hours	72 Hrs

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Determine volumes using cross-section method and cylindrical shell method.
CO2	Determine the arc lengths and areas of surface of revolution.
CO3	Understand double and triple integrals over rectangles, double integrals over general regions.
CO4	Determine the area of a region using double integration and volume of a surface using triple integrals in rectangular coordinates.
CO5	Understand separable variables, exact differential equation, homogeneous equations and Bernoulli's equations.
CO6	Solve the equations using substitution.
CO7	Understand surfaces and curves in three dimensions, linear equations of first order.
CO8	Determine the solution of equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.

Course	Details
Year / Semester	2/3
Type	Complementary Course
Code	MM3CMT01
Title	Vector Calculus, Analytic Geometry and Abstract Algebra
Credits	4
Hrs/Week	5 Hrs
Total Hours	90 Hrs

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Describe curves in space and their tangents, curvature and normal vector of a curve, directional derivatives and gradient vectors.
CO2	Describe line integrals, vector fields and line integrals, path independence.
CO3	Understand Green's theorem in the plane, Stokes' theorem, Divergence theorem.
CO4	Determine the arc length and curvature of a curve.
CO5	Discuss examples to verify Green's theorem, Stokes' theorem and Divergence theorem.
CO6	Describe polar coordinates, conic sections and conics in polar coordinates.
CO7	Understand groups, subgroups, cyclic groups, permutation groups and group homomorphism
CO8	Determine whether a given set with an operation is a group.

Course	Details
Year / Semester	2/4
Type	Complementary Course
Code	MM4CMT01
Title	Fourier Series, Laplace Transform And Complex Analysis
Credits	4
Hrs/Week	5 Hrs
Total Hours	90 Hrs

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the concepts of periodic functions, trigonometric series, Fourier series, odd and even functions.
CO2	Describe the concepts of Laplace transform, linearity, shifting, differentiation and integration of transforms.
CO3	Explain Cauchy Riemann equation, Laplace equation, Exponential function, Trigonometric function, Hyperbolic function
CO4	Understand line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, and derivatives of analytic functions.
CO5	Discuss examples to thorough the concepts of analytic function
CO6	Determine the powers and roots of complex number.
CO7	Determine the polar coordinates of complex number.
CO8	Determine whether a function is analytic or not.