Department of Mathematics
Learning outcomes for B. Sc Mathematics

Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study. A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning. Ability to analyze a problem, identify and define the computing requirements, which may be appropriate to its solution. Introduction to various courses like group theory, ring theory, field theory, metric spaces, number theory. Enhancing students' overall development and equipping them with mathematical modeling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment. Ability to pursue advanced studies and research in pure and applied mathematical science.

Program Specific Outcome of B.Sc. Mathematics

- Think in a critical manner.
- Know when there is a need for information, to be able to identify, locate,
- Evaluate, and effectively use that information for the issue or problem at hand.
- Formulate and develop mathematical arguments in a logical manner.
- Acquire good knowledge and understanding in advanced areas of mathematics and statistics, chosen by the student from the given courses.
- Understand, formulate and use quantitative models arising in social science, Business and other contexts.

Course: BS 101: Differential and Integral Calculus

After completion of this semester students will gain knowledge of –
Partial differentiation, Partial Derivatives, Geometrical representation of a Function of two Variables and Homogeneous Functions.

Theorem on Total Differentials, Maxima and Minima of functions of two variables, Lagrange's Method of undetermined multipliers.

Curvature and Evolutes and Properties of the evolute.
Envelopes One Parameter Family of Curves and Determination of Envelope.

Lengths of Plane Curves, Volumes and Surfaces of Revolution, Expression for the surface of revolution – Pappus Theorems - Surface of revolution.

Course: BS 201: Differential Equations

Student will be able to solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases. Student will be able to find the complete solution of a nonhomogeneous differential equation as a linear combination of the complementary function and a particular solution. Student will have a working knowledge of basic application problems described by second order linear differential equations with constant coefficients.

Course: BS 301: Real Analysis

After completion of this semester students will gain knowledge of –
Describe fundamental properties of the real numbers that lead to the formal development of real analysis. Comprehend rigorous arguments developing the theory underpinning real analysis. Demonstrate an understanding of limits and how they are used in sequences, series, Construct rigorous mathematical proofs of basic results in real analysis.

Student will be to understand differentiation and fundamental theorem in differentiation and various rules. Geometrical representation and problem solving on MVT and Rolls theorem. Finding extreme values of function. Describe fundamental properties of the real numbers that lead to the formal development of real analysis. Comprehend rigorous arguments developing the theory underpinning real analysis. Demonstrate an understanding of limits and how they are used in sequences, series, Construct rigorous mathematical proofs of basic results in real analysis. Understand Integrability and theorems on integrability. Study improper integration using Riemann integration.

Course: BS 401: Algebra

After completion of this semester students will gain knowledge of –
Understand the importance of algebraic properties with regard to working within various Number systems. Extend group structure to finite permutation groups (Caley Hamilton Theorem). Generate groups given specific conditions. Symmetry using group theory. Understand the importance of algebraic properties with regard to working within various number systems. Extend group structure to finite permutation groups (Caley Hamilton Theorem). Students will be able to define ring and subrings. Study of ideals and concept related to ideal. Study of various integral domain in ring. Introduction to field.

Course: BS 501: Linear Algebra

After completion of this semester students will gain knowledge of –
Introduction to vector space and subspace. Use computational techniques and algebraic skills essential for the study of systems of Linear equations, matrix algebra, vector spaces, eigenvalues and eigenvectors, Orthogonality and Diagonalization. (Computational and Algebraic Skills). Orthogonality and Least Squares : Inner Product, Length, and Orthogonality –Orthogonal Sets -Orthogonal Projections - The Gram-Schmidt Process.

Course: BS 601: Numerical Analysis

After completion of this semester students will gain knowledge of –
To apply appropriate numerical methods to solve the problem with most accuracy. Using appropriate numerical methods determine approximate solution of ODE and system of linear equation. Compare different methods in numerical analysis w.r.t. accuracy and efficiency of solution.

SEMESTER-I
Differential and Integral Calculus

Unit- I

Partial Differentiation: Introduction - Functions of two variables - Neighbourhood of a point (a, b) - Continuity of a Function of two variables, Continuity at a point - Limit of a Function of two variables - Partial Derivatives - Geometrical representation of a Function of two Variables -Homogeneous Functions.

Unit- II

Theorem on Total Differentials - Composite Functions - Differentiation of Composite Functions - Implicit Functions - Equality of fxy(a, b) and fyz(a, b) - Taylor's theorem for a function of two Variables - Maxima and Minima of functions of two variables – Lagrange's Method of undetermined multipliers.

Unit- III

Curvature and Evolutes: Introduction - Definition of Curvature - Radius of Curvature – Length of Arc as a Function, Derivative of arc - Radius of Curvature - Cartesian Equations – Newtonian Method - Centre of Curvature - Chord of Curvature. Evolutes: Evolutes and Involutes - Properties of the evolute. Envelopes: One Parameter Family of Curves - Consider the family of straight lines - Definition - Determination of Envelope.

Unit- IV

Lengths of Plane Curves: Introduction - Expression for the lengths of curves $y = f(x)$ - Expressions for the length of arcs $x = f(y)$; $x = f(t)$, $y = \phi(t)$; $r = f(\theta)$ Volumes and Surfaces of Revolution: Introduction - Expression for the volume obtained byrevolving about either axis - Expression for the volume obtained by revolving about any line - Area of the surface of the frustum of a cone - Expression for the surface of revolution – Pappus Theorems - Surface of revolution.

SEMESTER-II
1.2 Differential Equations

Unit- I

Differential Equations of first order and first degree: Introduction - Equations in which Variables are Separable - Homogeneous Differential Equations - Differential Equations Reducible to Homogeneous Form - Linear Differential Equations - Differential Equations Reducible to Linear Form - Exact differential equations - Integrating Factors - Change in variables - Total Differential Equations - Simultaneous Total Differential Equations - Equations of the form $dx\ P = dy\ Q = dz\ R$.

Unit- II

Differential Equations first order but not of first degree: Equations Solvable for p - Equations Solvable for y - Equations Solvable for x - Equations that do not contain x (or y)-Equations Homogeneous in x and y - Equations of the First Degree in x and y

- Clairaut's equation. Applications of First Order Differential Equations : Growth and Decay - Dynamics of Tumour Growth - Radioactivity and Carbon Dating - Compound Interest - Orthogonal Trajectories.

Unit- III

Higher order Linear Differential Equations: Solution of homogeneous linear differential equations with constant coefficients - Solution of non-homogeneous differential equations P(D)y = Q(x) with constant coefficients by means of polynomial operators when Q(x) = beax, b sin ax/b cos ax, bxk, V eax - Method of undetermined coefficients.

Unit- IV

Method of variation of parameters - Linear differential equations with non constant coefficients - The Cauchy - Euler Equation - Legendre's Linear Equations - Miscellaneous Differential Equations. Partial Differential Equations: Formation and solution- Equations easily integrable – Linear equations of first order.

SEMESTER-III
1.3 Real Analysis

Unit- I

Sequences: Limits of Sequences- A Discussion about Proofs-Limit Theorems for Sequences- Monotone Sequences and Cauchy Sequences -Subsequences-Lim sup's and Lim inf's-Series-Alternating Series and Integral Tests .

Unit- II

Continuity: Continuous Functions -Properties of Continuous Functions -Uniform Continuity - Limits of Functions

Unit- III

Differentiation: Basic Properties of the Derivative - The Mean Value Theorem - ∗ L'Hospital Rule - Taylor's Theorem.

Unit- IV

Integration : The Riemann Integral - Properties of Riemann Integral-Fundamental Theorem of Calculus.

SEMESTER-IV
1.4 Algebra

Unit- I

Groups: Definition and Examples of Groups- Elementary Properties of Groups-Finite Groups - Subgroups -Terminology and Notation -Subgroup Tests - Examples of Subgroups. Cyclic Groups: Properties of Cyclic Groups - Classification of Subgroups Cyclic Groups.

Unit- II

Permutation Groups: Definition and Notation -Cycle Notation-Properties of Permutations –A Check Digit Scheme Based on D5. Isomorphisms ; Motivation-Definition and Examples -Cayley's Theorem Properties of Isomorphisms -Automorphisms-Cosets and Lagrange's Theorem Properties of Cosets 138 - Lagrange's Theorem and Consequences-An Application of Cosets to Permutation Groups -The Rotation Group of a Cube and a Soccer Ball.

Unit- III

Normal Subgroups and Factor Groups: Normal Subgroups-Factor Groups -Applications of Factor Groups -Group Homomorphisms - Definition and Examples -Properties of Homomorphisms - The First Isomorphism Theorem.

Introduction to Rings: Motivation and Definition -Examples of Rings -Properties of Rings - Subrings. Integral Domains: Definition and Examples - Fields –Characteristics of a Ring.

Unit- IV

Ideals and Factor Rings: Ideals -Factor Rings -Prime Ideals and Maximal Ideals.

Ring Homomorphisms: Definition and Examples-Properties of Ring-Homomorphisms.

SEMESTER-V
1.5 Linear Algebra

Unit- I

Vector Spaces: Vector Spaces and Subspaces -Null Spaces, Column Spaces, and Linear Transformations -Linearly Independent Sets; Bases -Coordinate Systems -The Dimension of a Vector Space.

Unit- II

Rank-Change of Basis - Eigenvalues and Eigenvectors - The Characteristic Equation

Unit- III

Diagonalization -Eigenvectors and Linear Transformations -Complex Eigenvalues - Applications to Differential Equations.

Unit- IV

Orthogonality and Least Squares : Inner Product, Length, and Orthogonality –Orthogonal Sets -Orthogonal Projections - The Gram-Schmidt Process.

SEMESTER-VI
1.6 Numerical Analysis

Unit- I

Errors in Numerical Calculations - Solutions of Equations in One Variable: The Bisection
Method - The Iteration Method - The Method of False Position-Newton's Method - Muller's Method - solution of Systems of Nonlinear Equations.

Unit- II

Interpolation and Polynomial Approximation: Interpolation - Finite Differences - Differences of Polynomials - Newton's formula for Interpolation - Gauss's central differences formulae - Stirling's and Bessel's formula - Lagrange's Interpolation Polynomial - Divided Differences - Newton's General Interpolation formula - Inverse Interpolation.

Unit- III

Curve Fitting: Least Square Curve Fitting: Fitting a Straight Line-Nonlinear Curve Fitting. Numerical Differentiation and Integration: Numerical Differentiation - Numerical Integration: Trapezoidal Rule-Simpson's 1/3rd-Rule and Simpson's 3/8th-Rule - Boole's and Weddle's Rule - Newton's Cotes Integration Formulae.

Unit- IV

Numerical Solutions of Ordinary Differential Equations: Taylor's Series Method - Picard's Method - Euler's Methods - Runge Kutta Methods.